

BIOLOGICAL OCEANOGRAPHY COMMITTEE

by

VAGN HANSEN

1981

Belgium

(R. De Clerck and Ph. Polk)

The study concerned the interactions between the compartments in the plankton of different water masses.

1. Phytoplankton.

Study of the primary production in enclosed areas, near-shore and open sea.

Biomass measurements of the phytoplankton compartment.

Activity studies : - light-dependance of the particulate and extracellular production of the phytoplankton.

- Kinetically (quantitative) determinations of the phytoplankton extracellular organic matter, and phytoplankton respiration measurements.

2. Zooplankton.

Study of population dynamics of Copepodes : modelling of planktonic populations, population genetics of Harpacticoids.

Vertical migration behaviour.

Grazing activities of the dominant species in enclosed areas, near-shore and open seas.

Distribution patterns of fish eggs and fish-larvae.

Feeding behaviour in fish-larvae.

3. Bacterio-plankton.

Determination of dissolved organic matter : sugar, carbohydrates, BOD, TOC. Study of activities : total planktonic respiration ; specific heterotrophic activities : incorporation of radioactive substrates.

Canada

A.R. Longhurst

The following is a very brief summary of some of the relevant activities in Canada, for further details, please consult the individuals named in each section.

DEPARTMENT OF FISHERIES AND OCEANS

Marine Ecology Laboratory, Bedford Institute of Oceanography, Dartmouth, Nova Scotia B2Y 4A2. (Dr. K.H.Mann, Director)

This laboratory has continued to expand its inventory of field data from various climatic and oceanographic regimes. A major cruise, BIOSTAT, was made to the eastern tropical Pacific by all the scientists in the Biological Oceanography group and ten working days were devoted to the study of pelagic production processes at two oceanic sites. The sampling program during the BIOSTAT cruise was highly successful with series of zooplankton and mikronekton samples being collected from the surface to a depth of 1000 m at thirty different depth strata. These series of samples were taken during the day and night on both the Dome and BIOSTAT stations. Smaller groups participated in a three-week cruise off the Azores in collaboration with scientists from the Institute of Oceanographic Sciences in England and in a ship-of-opportunity program in the Canadian Arctic.

The Marine Ecology Laboratory has also continued to capitalize on the data banks established in earlier work for solutions to various theoretical problems; files already constitute an invaluable store of readily-accessible data that can be used for rapid numerical verification of many new ideas in pelagic ecology. As well, considerable progress has been made toward the development of a mechanistic model of the photosynthesis-light curve for phytoplankton. Early results look very promising.

BIONESS and LHPR sampling systems were successfully employed during the several major oceanographic investigations within the last year. Twenty-four profiles with LHPR during the 1980 Arctic program demonstrated quite a different distribution of zooplankton than those observed at lower latitudes. BIONESS was used extensively to show distribution patterns of micronekton on the BIOSTAT station.

In terms of site specific, mechanism-oriented studies, recent work has been focussed primarily on Georges Bank in relation to herring larval dispersion and retention mechanisms, and in the Southwestern Scotian Shelf area in relation to residual current patterns and lobster larval drift hypothesis. The field work for both of these projects has terminated and effort is being centered on analyses and interpretation.

In 1981 it was possible to extend inshore ecology activities into the Magdalen Shallows. This is the first part of the intended application of work carried out in Georges Bay to the southern Gulf of St. Lawrence. In the first instance,

the Marine Ecology Laboratory tried to establish relationships between the physical oceanographic structure and the standing stock and migration patterns of the plankton. This work will be extended in a further cruise planned for July 1982.

With regard to research into low-level responses and physiological stress, the Marine Ecology Laboratory continued to study the fate of oil spilled from the AMOCO CADIZ in three physically different shore-line sites: a high energy beach, a low energy estuarine system, and a very low energy salt marsh. A new deep-sea ecology program evaluating the approaches to be used and their implications for resource needs has been started.

The Bay of Fundy ecological study began in 1977 and 1981 marked the fifth consecutive year of field work. During this period a considerable body of data has been collected. Initially the emphasis was placed on conducting ecological and chemical surveys to help define the important environmental processes that influence the structure and dynamics of marine ecosystems in the Bay of Fundy.

Field work during 1981 was considerably less than previous years. Four sampling programs, not envisioned in September 1980, were conducted to help fill important data gaps: (i) a study of ice dynamics in Chignecto Bay over the winter months, (ii) a study of the production and export of Cumberland Basin salt marshes, (iii) a study of mysids in Cumberland Basin, and (iv) a study of physical, chemical and biological properties of intertidal sediments around the perimeter of Minas Basin. Most of the effort during 1981 was devoted to data analysis and preparing material for publication.

St. Andrew Biological Station, St. Andrews, New Brunswick
EOG 2X0 (Dr. R.H. Cook, Director)

The 1981³ surveys disclosed extremely rich deposits, 2,000 - 8,000 cm⁻³ Gonyaulax cysts in surface sediments of the southwestern Bay of Fundy. Variable weather conditions appeared to truncate Gonyaulax blooms which started to develop on three occasions during the summer and resultant toxin levels in zooplankton and shellfish were not as high as in previous years.

A benthic survey of the Bay of Fundy has been completed and the relationship between sediment, benthos and tidal currents determined.

Tag returns from shad, Alosa sapidissima, tagged in the upper Bay of Fundy confirm that the summer feeding population comprises fish from rivers on the Atlantic seaboard between Florida and Newfoundland. A counter-clockwise migration route within the Bay of Fundy is postulated.

Northwest Atlantic Fisheries Centre, St. John's, Newfoundland A1C 5X1 (Mr. M.C. Mercer, Director of Research and Resource Services).

Much of the work carried out by the Northwest Atlantic Fisheries Centre on biological oceanography is involved with

the Flemish Cap Project, with results being presented annually through NAFO. This work began in 1981, involving examination of physical and biological parameters related to fish recruitment. Study results so far have indicated high mortality associated with redfish larvae in 1979, although time of peak extrusion, growth rate and onset of spring production were not significantly different during that year. Recent work has concentrated on improved estimates of sampling variability and environmental variation, and lab rearing of redfish larvae.

During 1981 work was carried out jointly with Memorial University of Newfoundland examining canyon processes, as these affect the physical water structure and adjacent shelf productivity. Preliminary work indicates enhanced production at the shelf-break, and possible advection of nutrient enriched water onto the shelf in the region of Lilly Canyon. These canyons may be instrumental in driving production along the eastern boundary of the Grand Banks.

Arctic Biological Station, Ste. Anne de Bellevue, Quebec
H9X 3R4 (Dr. A.W. Mansfield, Director)

At the Arctic Biological Station a wide range of integrated, long-term investigations of the structure and functioning of arctic coastal marine ecosystems are currently in progress. Studies on standing stock, species composition vertical distribution, community structure and rates of primary production of phytoplankton in both the water column and sea ice were carried out throughout the year. Diurnal and tidal cycles as well as the influence of environmental factors such as solar energy input, temperature, salinity and nutrient availability were also examined. Primary production rates of selected species of seaweed were measured during the open water season.

A study of the fauna associated with sea ice was continued, with emphasis on species composition, abundance and trophic and other relationships between ice and water animals. A study of the species composition and abundance during the winter of arctic deep water zooplankton was completed. Studies on the seasonal ecology, physiology and bioenergetics of four dominant macrozooplankton species in Frobisher Bay are continuing. Research into the relationship between detrital fall-out and zoobenthic production are in progress. Initial emphasis is on the rate of deposition of detrital material at different times of the year, its composition and potential food value. Other studies dealing with the structure and stability of arctic zoobenthic communities are continuing. Studies were carried out on seasonal bacterial heterotrophy in the water column in several areas of the arctic, and on the bacterial activity in underice communities. Microbiological studies are also continuing on an area of arctic coastline experimentally contaminated with crude oil.

Publications dealt with a checklist of arctic marine phytoplankton and sea ice algae, primary production in a number of arctic areas, abundance and heterotrophic activity of arctic marine bacteria and on the biochemical composition and energy content of zooplankton.

Champlain Centre for Marine Science and Surveys, Quebec City,
Quebec G1K 7X7 (Dr. J. Piuze, Director)

L'étude de la variabilité du système de production biologique de l'estuaire du Saint-Laurent s'est poursuivie en 1981 et les résultats indiquent que les débits d'eau douce dans cet estuaire pourraient influencer fortement le patron de la distribution temporelle et spatiale du phytoplancton. Il a été démontré que la variance des observations dans cet estuaire augmentait de façon exponentielle en fonction de la fréquence ou de l'échelle temporelle d'observation et il a de plus été noté que cette variance pourrait varier en fonction de la saison. D'autres travaux ont montré que le courant de marée pouvait avoir une influence déterminante sur la morphologie des "taches" de phytoplancton. Par ailleurs, des travaux ont également été réalisés pour étudier les variations endogènes du phytoplancton dans l'estuaire du Saint-Laurent. D'autres études sur le phytoplancton des glaces de cet estuaire ont aussi été complétées. Un nouveau programme pour étudier les mécanismes de formation et de maintien

des agrégations de zooplancton a été mis sur pied.

DALHOUSIE UNIVERSITY

Department of Oceanography, Dalhousie University, Halifax,
Nova Scotia B3H 4J1)Dr. R.O. Fournier, Chairman)

The Department of Oceanography has five full-time faculty members in biological oceanography plus one Research Associate, one Postdoctoral Fellow and about 28 graduate students. The research of this entire group is focussed to some extent around the major interests of the faculty, which is briefly described below.

Zooplankton research is underway to study the distribution and abundance of the zooplankton of the Gulf of Maine using a ship-of-opportunity. Weekly measurements of animals, plants and water temperature are carried out to provide a better understanding of the plankton in that area. Investigations are also underway on the swarming behaviour of the euphausiid Meganyctiphanes norvegica, the distribution of acantharia in the northwest Atlantic, resource partitioning by copepods and finally the trophic biology of planktonic protozoa of the genus Strombidium in relation to size and abundance of food organisms.

A study of the plankton ecology of the Scotian Shelf continues with a continuing emphasis on fronts, upwelling and the effects of cross-shelf mixing. Additional studies include work on the subsurface chlorophyll maximum, bacteria-phyto-

plankton linkages in the euphotic zone, the effect of low light and low growth on N:P ratios in phytoplankton, an estimate of the rate of nitrogen regeneration in the euphotic zone across the shelf and finally an attempt is being made to look at the budget for chlorophyll-a during the normal seasonal cycle for a temperate phytoplankton community.

Emphasis in fisheries ecology is presently being directed toward understanding the ecology of the recruitment process with a strong interest in local herring populations. Work has been carried out in the Bras d'Or Lakes of Cape Breton and the upwelling site off southwestern Nova Scotia. Additional studies include an attempt to look at growth and energetics of cod, a study of ecology of Amazon River flood plain fish and finally an ecological study of larval white hake in Georges Bay, Nova Scotia.

The department is concerned with the representation of ecological systems using mathematical models of the physical-biological interactions in warm-core rings plus a study of the relative influence of predation on shaping the spectrum of particle sizes in the marine ecosystem. An equation predicting the mortality rate of fish sized particles was derived using allometric laws of growth and metabolism.

An investigation in the benthic ecosystem is underway of how C^{13} can be used as a tracer to monitor food transfer in the food chain. This technique should be able to demonstrate both food chain complexity as well as efficiencies. Thus far results show classical relationships except that "herbivorous" copepods appear to be feeding to a surprising degree as carnivores or on detritus. Additional studies include work on the distribution of pelagic sea birds in Cabot Strait, a study of the availability and quality of lobster food in and away from areas that have been devastated by sea urchin grazing and finally a study of intertidal sediments with an eye toward understanding the quality and quantity of components encountered by infaunal animals.

MCGILL UNIVERSITY

Marine Sciences Centre, McGill University, Montreal, Quebec
H3A 2B2 (Dr. R.G. Ingram, Chairman)

Studies have been continued in the Gulf of St. Lawrence of the ice biota (principally diatoms), the distribution of oxygen (especially the association of the oxygen minimum layer with nutrient levels), and the movement of water masses in the northeastern Gulf. In the western Arctic, involvement has been in ecological studies of the Arctic fox which in certain areas depends entirely upon marine sources of food. Work on an isopod crustacean which lives in both fresh and salt water in the Western Arctic is nearly completed. In the eastern Arctic, work has continued on the biology of an unusual landlocked mussel (*Mytilus*) and in changes in marine climates -- the northwest Atlantic-Subarctic region -- as evidenced by changes in the marine fauna since 1920.

Studies on the functional morphology of feeding and locomotion in harpacticoid copepod (Crustacea) have continued. A joint project with ecologists at Harvard University and the University of Rhode Island was begun to study the effects of oil pollution on marine faunas and floras as part of the ongoing MERL program of URI. This joint venture was funded by USA/NOAA. An analysis was completed of the structure of zooplankton communities in the St. Lawrence estuary, and measurements are underway of the interactive effects of changing salinity and heavy metal concentration on the growth of a fresh water and marine algae.

Denmark

(Vagn Hansen)

The Danish Institute for Fishery and Marine Research

The Experimental Department, Charlottenlund. (J. Beyer)

The department has been heavily engaged in creating the basis for future research. Activities to provide controlled biological material are in good progress. This involved for example cryopreservation of marine fish eggs and copepod monoculturing on the small scale in the Charlottenlund Laboratory. Basic activities to develop sensors for detecting species, size, abundance and distribution of the small organisms in the sea have been started at the end of the year as a laboratory project. This long-term project is carried out in co-operation with the Danish Academy of Technical Science and the Institute of Physical Oceanography in Copenhagen. A Scandinavian meeting on transducer developments was held at Charlottenlund Castle. The department was in charge of the Danish participation in the ICES herring larval survey with the new research vessel DANA. The very first pilot-experiments to provide the basis for future field research in understanding the early life-history dynamics of North Sea herring was carried out. Fertilized herring eggs were provided by Dr. Gamble at the Aberdeen Laboratory and kept in one of DANA's controlled aquarium systems during the cruises.

In the Charlottenlund Laboratory, feed-starvation-feed experiments with larval herring has been carried out in collaboration with Dr. Theilacker from the Southwest Center of the National Marine Fisheries Service. The work also included digestion studies of larval herring.

At the end of the year the building of a new laboratory in the North Sea Centre at Hirtshals has begun. This facility is designed to bigger scale experimentation including experimental ecosystems.

Biological Oceanography Department. (Vagn Olsen)

The ongoing changes in the operations of the Institute have caused a decrease in the oceanographic research projects. However a minimum of ICES obligations have been met.

During most of the DANA cruises, time was spent on trimming the equipment and training the personel.

In August a long-term project on the Jutland Current was initiated, the first one week cruise was operated together with the cooperating institutions, Institute of Physical Oceanography and the Marine Pollution Laboratory. Two cruises will be completed in 1982.

In the Baltic standard hydrographic observations were made during the November herring and cod programme.

Grønlands Fiskeriundersøgelser. Greenland waters. (E. Smidt).

Plankton

Sampling of zooplankton with stramin net (2 m diameter ring, mesh aperture 1 mm) and with bongo sampler (60 cm diameter ring, mesh aperture 0.5 mm) was made in July at the Standard Oceanographic Sections in Davis Strait from Fylla Bank to Egedesminde, in the area west of Disco, and in Disco Bay. Half hour oblique hauls were made from about 50 m depth. Only stramin net hauls have been worked up, volume having been measured, and fish eggs and larvae have been sorted, identified and counted.

Marine Biological Laboratory, Elsinore, Copenhagen University,
(Aa.Møller Christensen.)

Taxonomy and faunistics:

Preben Jensen has continued his work on nematods and other meiofauna organisms. The work includes a project "Behaviour and ecology of Baltic nematods", which is run in cooperation with foreign colleagues. The work has also included a revision of the family Meyliidae, work on the distribution and ecological preferences of Comesomatidae, studies on the sampling efficiency of the "Haps" sampler and the construction of a new "sample splitter" for meiofauna.

Kurt W. Ockelmann has found two new species of mussels and has been working on the taxonomic and phylogenetic significance of ontogenetic hinge patterns.

Grethe Møller Christensen has established that the plankton alga Phaeodactylum tricornutum comprises at least three well defined species with different patterns of distribution.

Aage Møller Christensen has cooperated with George Shinn, University of Washington, on a new species of the parasitic turbellaria genus Kronborgia. The work on the female is finished, but the male is not found yet. A publication on the geographical and bathymetric distribution of the Fecampiids is presently in press.

Morphology, functional and general biology:

Claus Nielsen has continued his studies on the polypid patterns of cyclostomic bryozoans. He has further been studying the ciliation of larvae of marine invertebrates. This is part of a project 'The phylogeny of metazoans - a review with emphasis on functional aspects and life cycles'.

Preben Jensen has studied the reproductive biology of freeliving nematods, especially Chromadorita tenuis, on which studies on feeding, phytochemical sensitivity and swimming behaviour have been done as well.

Kurt W. Ockelmann has studied the functional morphology and biology of the mytilid Crenella decussata.

Kirsten Muus has started a comprehensive project on identification of newly settled mussels of all known species from Øresund

and Kattegat. The purpose is to provide photographs and descriptions of value to other scientists working on juvenile mussels.

W. Nicolaisen and E. Kannevorf have continued their work on the amphipod genus Bathyporeia. The work includes studies on oxygen assimilation, survival at low oxygen tensions, migrations, reproduction, productivity and the cyclus of sexual maturity.

Marianne Køie has continued work on life cycles of marine fish trematodes.

A work on the digene trematodes of cod- and flatfishes has been started in order to assess the possibility of using these parasites as biological tags.

Thomas Kiørboe and Flemming Møhlenberg have finished the experimental work on the feeding biology of filtering mussels, copepods and Macoma baltica. Field studies on feeding rates of copepods have been completed.

Physiology:

Lars Hagerman has finished a study on the influence of salinity acclimatisation on the osmoregulation of Crangon vulgaris and Praunus flexuosus. Work on the influence of oxygen deficit on osmo- and ionic regulation of Crangon vulgaris has been completed as well. Current studies include work on water movement over the gills and oxygen assimilation of juvenile Homarus vulgaris and the influence of starvation and food type on the haemocyanin concentration found in the same species.

Population analysis, synecology :

Hans Christensen and Willy Nicolaisen have continued their studies on species composition and biomass of plankton populations in Øresund. This is part of a project "Dynamics and composition of organic material in the pelagic zone of Øresund".

FINLAND

No report received.

France

(N. Lacroix)

MINISTERE DE LA MER

INSTITUT SCIENTIFIQUE ET TECHNIQUE DES PECHEES MARITIMES (ISTPM)

Recherche au niveau de la gestion des stocks halieutiques : étude de l'ichthyoplancton pour la détermination des stocks de géniteurs. Participation aux travaux internationaux en ce qui concerne les larves de hareng en mer du Nord.

Structure et évolution d'une fraction des peuplements zooplanctoniques, essentiellement oeufs et larves d'espèces exploitables (crustacés et poissons) en relation avec l'installation sur le littoral de centrales électriques de grande puissance. Les secteurs étudiés comprennent les côtes du sud de la mer du Nord, de la Manche et du nord du golfe de Gascogne.

Etude de la production phytoplanctonique et de la biomasse bactérienne du bassin de Marennes-Oléron (zone estuarienne du golfe de Gascogne). Valeur nutritive du milieu pour les mollusques.

Bilan des phénomènes d'eaux colorées et des perturbations observées dans le phytoplancton côtier du littoral français.

Etudes sur l'utilisation des cultures d'algues marines unicellulaires en écotoxicologie.

CENTRE NATIONAL POUR L'EXPLOITATION DES OCEANS (CNEXO)

Ecosystème benthique profond : analyse des possibilités de réaction de l'écosystème à une perturbation, voies d'échange et bilan énergétique des populations de l'interface eau-sédiment.

Ecosystème pélagique : étude des processus de production à partir de l'utilisation du matériel organique particulière par le zooplancton et sous l'influence des structures physiques.

Etude de l'écosystème pélagique du front thermo-halin Liguro-provençal ; étude du cycle annuel des populations planctoniques des côtes nord-Finistère ; étude des fronts thermiques en mer d'Iroise ; programme SATIR.

Communautés liées à l'hydrothermalisme sous-marin : aspects descriptifs et fonctionnels : liaisons entre les rythmes biologique et celui des émissions hydrothermales.

UNIVERSITE DE PROVENCE - AIX MARSEILLE

LABORATOIRE DE BIOLOGIE ANIMALE (PLANCTON) MARSEILLE

Etude infraspécifique des Hoplophoridés (Crustacés décapodes pélagiques) des croisières du "Dana" (1922-1930) dans l'Atlantique. Relations écologiques.

Ecophysiologie : poursuite des recherches ultrastructurales et cytochimiques sur la digestion et l'ovogénèse des Copepodes pélagiques.

Ultrastructure comparée des yeux du Chaetognathe benthique SPADILLA CEPHALOPTERA ; comparaison avec ceux des espèces pélagiques.

Synthèse sur cycles de vie et biogéographie. Exemples pris dans le plancton de la province atlanto-méditerranéenne.

STATION MARINE d'ENDOUME

Dynamique de la production organique primaire dans les systèmes d'apport nutritif directs, principalement d'origine profonde (upwelling côtiers, divergences du large) et secondairement d'origine terrestre (systèmes de dilution locaux). La dynamique des écosystèmes est analysée par le biais d'une approche théorique (modélisation faisant intervenir les données de cynétique d'assimilation du C et de N et les données hydrodynamiques). Les incidences des facteurs de pollution sur l'écosystème et les compositions du plancton marin sont examinées au moyen d'analyses statistiques.

Etude de l'évolution dynamique dans le temps et dans l'espace, des peuplements macrobenthiques, notamment des substrats meubles, en fonction des variations naturelles (climatique, courantologiques, sédimentologiques ou des perturbations apportées par l'activité humaine).

Mise en évidence expérimentale (in vivo et in vitro) des processus biologiques et physiologiques conduisant aux déséquilibres des populations et communautés telles qu'elles sont observées dans le milieu naturel.

Etude des peuplements installés sur substrat dur ; inventaires, dynamique, évolution en fonction des conditions et des transformations (naturelles et dues à l'homme) du milieu.

Evaluation du flux d'énergie transitant dans le réseau trophique lié aux biocoénoses benthiques de fonds meubles. Relation (Benthos/Pelagos - Microphytobenthos/Meiobenthos - Meiobenthos/Macro-benthos - Meio-macrobenthos/Mégabenthos vagile. Au sein du Macro-benthos relations Proies/Prédateurs.

Etude de l'activité des micro-organismes marins dans les eaux côtières et lagunaires et dans les milieux marins perturbés, au moyen de méthodes expérimentales pratiques in situ et in vitro.

Distribution et évolution des constituants biochimiques de la matière organique dans l'eau et les sédiments marins, en relation avec l'activité biologique.

Etude systématique, écologique et dynamique de la phase embryonnaire et larvaire des téléostéens en milieu naturel. Transferts d'énergie à partir du comportement alimentaire, des besoins nutritionnels et des rendements énergétiques. Etude écophysiologique : adaptations enzymatiques, rythmes alimentaires et équilibre hydrominéral.

Systématique évolutive d'invertébrés (spongiaires, Brachiopodes, Phoronidiens), basée sur la taxonomie, l'écologie et la cytologie comparée des formes actuelles, et leurs relations avec des formes fossiles apparentées. Interactions entre hôte et parasite dans une association de type parasitaire.

UNIVERSITE DE NANTES

LABORATOIRE DE BIOLOGIE MARINE NANTES

Etude du fonctionnement d'un écosystème estuarien (Loire). Distributions saisonnières de l'ichtyofaune reliées aux conditions hydrologiques du fleuve.

Mise en évidence d'un certain nombre de corrélations entre les compositions qualitatives et quantitatives des divers peuplements des grandes vasières estuariennes avant modification du milieu par des travaux d'aménagement.

Etude des écosystèmes littoraux (dont marais littoraux).

Recherches dans la zone ostréicole de la baie de Bourgneuf : identification du phytoplancton et du microphytobenthos. Culture de diatomées (en laboratoire) pour la nourriture des huîtres.

UNIVERSITE DE BRETAGNE OCCIDENTALE

LABORATOIRE d'OCEANOGRAPHIE BIOLOGIQUE, BREST

Recherches sur la connaissance de l'écosystème côtier et de son fonctionnement : étude du benthos de la plate-forme continentale nord-Gascogne, recherches sur la macrofaune, le microphytobenthos et le meiobenthos. Ce secteur fait l'objet d'un suivi écologique à long terme afin de comprendre le fonctionnement normal de l'écosystème benthique et de dégager les fluctuations temporelles.

Recherches sur le pélagos. Les études sont réalisées dans la zone du front thermique ouest-Bretagne. Confrontation des données de terrain avec les résultats de télédétection satellitaire (programme SATIR).

UNIVERSITE PIERRE ET MARIE CURIE - Paris

LABORATOIRE ARAGO, Banuyls-sur-Mer

Etude de l'écosystème pélagique :

- production primaire pélagique : structure et rendements des communautés phytoplanctoniques naturelles du point de vue de l'assimilation du carbone : utilisation de la lumière - efficacité du système pigmentaire - rôle des éléments nutritionnels et des vitamines. Cette approche vise à définir avec précision les éléments limitant la photosynthèse pélagique dans les régions de remontée d'eau profonde et les zones de divergence ;

- production secondaire pélagique , bilan énergétique au nitrophique. Structure quantitative et qualitative des communautés de copépodes pélagiques dans différentes aires géographiques: recherches de constantes écologiques - indice de stabilité des biomasses - constitution élémentaire - valeur calorifique - détermination des conditions trophiques et de l'état des communautés - étude fine des différents paramètres de la production secondaire en zone néritique : dynamique de population et production, respiration, croissance et reproduction.

Etude de la structure et du fonctionnement de l'écosystème benthique. Production, bilan et flux énergétique aux différents échelons. Dynamique des populations des espèces principales et cycles biologique in situ. Budgets énergétiques - Relations eau surnageante - sédiments - matière organique - bactéries - mangeurs de dépôts et filtreurs. Relations meiofaune - prédateurs.

Recherches en biologie cellulaire. Cytologie ultrastructurale des Dinoflagellés libres et parasites.

STATION MARINE DE VILLEFRANCHE-SUR-MER

Etude de la dynamique des populations en microécosystèmes ; biologie et écophysiologie du zooplancton et du phytoplancton ; recherche sur les complexants d'origine planctonique dans l'eau de mer ; acquisition et traitement statistiques des données océanographiques ; biochimie des transferts trophiques ; écologie du microzooplancton ; reproduction des organismes marins.

STATION BIOLOGIQUE DE ROSCOFF

Etude des écosystèmes benthiques de la Manche en conditions naturelles ou perturbées.

Etude d'écosystèmes littoraux et estuariens (baie de Morlaix) : rôle de phytoplancton, du microphytobenthos, des bactéries, du microbiotecton et de la meiofaune.

Etude des acides gras des microvibrions marins.

Etude comparée de chlorophycées marines des côtes françaises se rattachant aux genres Ulothrix et Urospora. Les résultats obtenus portent sur les modalités de reproduction en fonction des facteurs du milieu.

Etudes des peuplements d'algues benthiques de la Manche et de l'Atlantique-nord.

UNIVERSITE DES SCIENCES ET TECHNIQUES DE LILLE

STATION MARINE DE WIMEREUX

Etude de l'hydrobiologie du détroit du Pas-de-Calais, connaissances physicochimiques et productivités pélagiques (phyto- et zooplancton). Etude des peuplements benthiques.

Recherches molysmologiques dans les zones littorales proches de Calais - Dunkerque (Manche orientale).

Etude de la nocivité de différents polluants sur les chaînes alimentaires.

AUTRES ETABLISSEMENTS

COLLEGE DE FRANCE

LABORATOIRE DE BIOLOGIE MARINE - CONCARNEAU

Alimentation des principales espèces benthiques d'intérêt économique (morue, lieu noir, églefin, merlan, cardine) dans la zone géographique comprise entre les Shetland et le golfe de Gascogne.

INSTITUT OCEANOGRAPHIQUE, Paris

Etude de la toxicité de différents hydrocarbures aromatiques polynucléaires sur le plancton.

Recherches sur les processus d'adaptation à la lumière chez les copépodes marins, (Pontellidés). Influence du facteur lumière sur les migrations verticales de ces espèces.

Recherches photochimiques : étude de la phototransformation de certaines des fractions de la matière organique dissoute des eaux de mer.

German Democratic Republic

(E.A. Arndt)

The long-term observations in the Baltic Sea of biological parameters (chlorophyll, phytoplankton, primary productivity, zooplankton) have been continued at the Institute of Marine Research of the Academy of Science of the GDR during 1981 at national and international standard stations.

In cooperation with the Section of Biology of the Wilhelm-Pieck-University of Rostock in this programme, which fulfils also the requirements in the frame of the Baltic Sea Monitoring Programme, of the HELCOM, also meteorological as well as physical and chemical parameters have been measured.

A special programme DEKEX '81 was carried out in spring 1981 in the Arkona sea. Three weeks, starting just before the onset of the phytoplankton spring bloom, physical, chemical and biological parameters have been measured with very high observation frequency (1 - 3 hours). Simultaneously to this time series ecological experiments were performed, in which the spring outburst of the phytoplankton and the corresponding metabolic processes in the water were studied in plastic bags.

The Department of Marine Biology of the Wilhelm-Pieck-University Rostock continued the qualitative and quantitative analysis of the phytoplankton, zooplankton and zoobenthos samples taken in connection with the BMP of HELCOM. Furthermore, qualitative and quantitative studies were undertaken on the phytoplankton and zooplankton in the Greifswalder Bodden, at a few stations on the seaward coast of Ruegen and at several stations in the Mecklenburg Bight, Arkona Sea, Bornholm Sea and Gotland Sea in order to obtain information regarding the food available to the larvae, juveniles and adults of the Ruegen spring herring.

The Section of Biology of the Wilhelm-Pieck-University Rostock also continued its work on the complex ecosystem analysis of the chain of boddens south of Darss-Zingst.

Main attention was paid to the following aspects:

- recording of meteorological, hydrological and biological primary data (phytoplankton, zooplankton, micro- and macrophyto-benthos, meio- and macrozoobenthos).
- New insights on the reaction capacity of the system under the influence of different ammonium inputs are obtained in experiments with isolated parts of the water column in plastic bags (diurnal rhythm of free ammonium content).

Federal Republic of Germany-

(J. Lenz)

Institut für Meereskunde, Kiel

Baltic Sea (Kiel Bight)

The regular sampling programme for chemical and biological data including the measurement of primary production within the framework of the International Baltic Sea Monitoring Programme was continued at three fixed stations in Kiel Bight. The planktological group of the interdisciplinary Joint Research Programme SFB 95 at Kiel University working on 'Interaction between sea and sea bed' confirmed, by employing sediment traps, earlier results that most of the phytoplankton spring bloom sediments uneaten to the bottom in the shallow areas of the Western Baltic.

The population structure and dynamics of the three dominant copepod species in Kiel Bight Pseudocalanus elongatus, Centropages hamatus and Oithona similis was studied from late winter to early summer, showing the general predominance of young life stages also during the cold season before the onset of the phytoplankton spring bloom.

The population dynamics and biochemical composition of the ctenophore Pleurobrachia pileus, one of the main planktic predators in the area, were investigated. Its irregular occurrence was found to be closely correlated to the inflow of high-saline bottom water into Kiel Bight.

The interactions between phytoplankton, bacteria and bacteria-grazing ciliates and other microzooplankton were studied at the entrance of the highly eutrophicated Schlei Fjord. These field studies were supplemented by laboratory experiments on bacteria as food for ciliates.

A special study dealt with bacterial populations in neuston films sampled in the Kiel Fjord.

An investigation into the size structure of a zoobenthos community was started as well as a long-term comparative study on how climate influences changes in macrobenthos populations in Kiel Bight and the German Bight (Southern North Sea).

After the catastrophic damage to the benthic fauna below the 20 m depth contour this autumn because of oxygen depletion and H₂S formation, we started to trace the process of recolonization.

North Sea and North Atlantic

Marine egg and larvae surveys were continued in the North Sea and west of Ireland. Stomach content analyses of juveniles showed cannibalism in a high percentage.

The third cruise of RV 'Poseidon' to the Portuguese shelf area was devoted to microbiological work on different aspects of bacterial biomass and activity in the pelagic compartment of the ecosystem.

Data processing and interpretation of the two earlier planktological cruises were continued. A comparison between daily primary production by phytoplankton and respiration in the water column measured by the ETS method showed a production surplus of 38% in spring.

To measure the sedimentation rate of particulate matter in the open Atlantic for the first time, 4 sediment traps were lowered to a depth of 110 m and fixed to satellite-tracked oceanographic drift buoys, which will be recovered after a drifting time of six months.

Biologische Anstalt Helgoland

Routine measurements of hydrographical, chemical and biological parameters have been continued at Helgoland Roads (54° 11,3'N 07° 54,0'E). Five times a week, temperature, salinity, nutrients (PO_4 , NO_3 , NO_2 , NH_4 , SiO_2), yellow substances ('Gelbstoff') and biomass as organic carbon, derived from microscopic counts (inverted microscope), were measured.

In addition once a week, bacterial numbers (pour plate method) in the surface film and at a depth of 1 m were determined and BOD, TOC and surface tension measured. In the 1 m samples luminescent bacteria and oil degrading microorganisms were counted.

Monthly cruises from Helgoland to the estuaries of the Elbe River, the Eider River, and the Weser River for hydrographical, chemical and biological investigations have been continued.

The long-term ecological studies on seasonal and spatial distribution of Noctiluca miliaris in the German Bight have been continued. Seasonal fluctuations and annual abundance of this dominant dinoflagellate have now continuously been recorded over a period of 13 years at Helgoland Roads.

Seston and plankton distribution studies in the German Bight (east of 6° 25'E and south of 55° 10'N) were continued. Horizontal and vertical distribution of suspended particulate matter and phytoplankton stocks was measured during two cruises with R.V. 'Gauss' from the German Hydrographic Institute. 76 stations were visited from 12-21 June, 73 stations from 17-24 August, 1981. The latter cruise covered a red tide occurrence caused by the dinoflagellate Ceratium furca.

Ecological studies in the 'Königshafen', a semi-enclosed embayment of the wadden sea of Sylt (German Bight) were continued. Seston, phytoplankton and mesozooplankton components were analyzed together with hydrographical parameters (temperature, salinity, nutrients, oxygen) in the course of the year. In addition, the oxygen consumption of mesozooplankton communities was studied.

Iceland

Phytoplankton (Th. Thórdardóttir)

The work on phytoplankton and primary production in Icelandic waters was conducted much along the same lines as in previous years. The monitoring of primary production and Chl a in May - June and August in coastal and oceanic waters around Iceland was carried on. Similarly, the repeated measurements during early spring on the spawning and hatching grounds off the south and west coasts were continued. At Isafjardardjúp and off the island of Grimsey weekly samples for Chl a measurements and quantitative analysis of phytoplankton were collected. Besides these monitoring programs primary production and Chl a was measured in late May in the waters off the southeast and east coasts and the following east coasts fjords: Berufjörður, Mjóifjörður and Seyðisfjörður.

During the spring cruises 27 P/I curves were constructed for phytoplankton from different localities and at several stations comparison between in situ and incubator productivity was made. In total 2500 and 600 measurements on primary productivity and Chl a were made respectively.

Zooplankton (I. Hallgrímsson)

From April to June regular zooplankton sampling was carried out in Icelandic waters both inshore and offshore; totally 394 stations were worked. These surveys were in general continuation of previous sampling and included observations of fish eggs and larvae as well as shrimp larvae.

The samplings were carried out with Hensen and Juday nets, Icelandic High Speed Samplers and Gulf III samplers. Furthermore, experimental zooplankton pumping from various depths was worked.

As previously fish larvae sampling was also carried out in spring in the Irminger Sea and in East-Greenland waters.

The continuous plankton survey between Reykjavík and New York and Reykjavík and Sule Skerry, worked in cooperation with the Institute for Marine Environmental Research, Plymouth, were still in progress.

Ireland
(B. McK. Bary and M.M. Parker)

1. Department of Fisheries & Forestry

Collection of observation and data on marine algal blooms continues (see details in Administrative Report to MEQC).

2. University College, Galway; Faculty of Marine Science.

a) Department of Zoology, Benthos Research Team.
Extensive and intensive studies of hard and soft bottom benthos in Galway Bay and Kinsale continued, with particular attention being paid to the biology and autecology of key species. The team is participating in the EEC's COST Project 47 on coastal benthic ecology. An investigation on colonisation of the seabed by the cucumarian Neopendactyla mixta, in association with members of the Oceanography and Microbiology Departments continues.

b) Department of Microbiology

Members of the Department are participating in cruises organised by the Scottish Marine Biological Association & Herriot-Watt University Edinburgh, in order to study metabolic activity of deep-sea benthos, concentrating on heterotrophic oxygen uptake.

c) Department of Oceanography

Biological Oceanography in the Department of Oceanography, University College, Galway, is based on simultaneous sampling of zoo- and /or phyto-plankton and the chemical and physical properties of the waters of bays and estuaries along the western and southern Irish coasts. Research in hand concerns fluctuations in numbers and environmental relationships of Calanus finmarchicus and C.helgolandicus: occurrences of fish larvae in oceanic and neritic waters and their relations to water properties; and planktonic indicators of two-way flow through a strait. Phytoplankton, with emphasis towards red-tide, is studied off the south coast and in the

Shannon estuary. A study in which primary productivity will be compared for three differing kinds of environmental conditions, is commencing.

A series of papers is in press by Yip, Shuet Li on the biology and relationships to oceanographic conditions of Pleurobrachia pileus and other Ctenophora of western Irish waters.

3. Shellfish Research Laboratory, Carna, Co. Galway

Examination of oceanographic conditions related to algal bloom events on the Co. Galway coast continues. Qualitative and quantitative estimates of seasonal abundance of phytoplankton and of molluscan bivalve larvae continue.

Netherlands

No report received.

Norway

(G.Berge)

1. Institute of Marine Research, Bergen and
Biological Station Flødevigen, Arendal.

1.1 Phytoplankton

1.1.1 The monitoring of primary production and standing stocks of phytoplankton of the coastal banks off western and northern Norway continued for the 6th year, covering the spring season three times at six sections across the Norwegian economic zone. The results are being combined with the previous material in a study of the annual primary production and its fluctuations. The study constitutes a component of a biological baseline and monitoring study related to the oil exploitation programme on the shelf. The following parameters are included: primary production rates, chlorophyll *a*, hydrography, nutrients and zooplankton. Turbidity and chlorophyll *in vivo* fluorescence were continuously recorded at the 5 m level (IMR).

1.1.2 A long-term programme on environmental conditions in the Norwegian fjords (IMR) was continued. About 30 fjords along the whole Norwegian coast were surveyed in November - December and samples for analysis of nutrients, oxygen, salinity and temperature were collected (IMR). All data have been analyzed using a computer program designed in 1980.

1.1.3 The study of the phytoplankton and its primary production at the ice edge in the Barents Sea was continued in 1981. In order to get an idea of the seasonal variations, three cruises were carried out in 1981, one in early May, one in June-July and one in mid August. On the phytoplankton field work, emphasis was put on determining light-photosynthesis relationships for natural phytoplankton populations for the different seasons. This study is part of an interdisciplinary program designed to investigate the biological production processes in this important fishing areas.

1.1.4 Effects of Ekofisk crude oil on phytoplankton has been studied on diluted natural populations and on unialgal cultures (BSF).

1.1.5 Nitrate, orthophosphate, chlorophyll *a* and fixed samples of phytoplankton are analyzed from stations along the hydrographical section Torungen - Hirtshals i Skagerrak (BSF).

1.2 Zooplankton

1.2.1 At 6 permanent oceanographic stations along the coast the routine sampling of zooplankton by Juday 36/180 m nets continued. Zooplankton volumes, species composition and stages developments are recorded.

1.2.2 As a component of the Joint Coastal Current Programme as well as the Biological Baseline and Monitoring Programme (see 1.1.1) related to oil exploration and exploitation north of N 62°0', zooplankton sampling was made in duplicate at 26 stations on five sections across the shelf. The stations were each operated 3-5 times during the year. Additionally, once a week vertical hauls 200-0 m and 50-0 m were made from weather ship "Ami" at N 71°30' and E 19°00'. The material was worked as for 1.2.1.

1.2.3 A study of the zooplankton at the ice edge in the Barents Sea was started in summer 1979. This study is part of an interdisciplinary programme designed to investigate the biological production processes in this important fishing area (See 1.1.3). (In 1981 approx. 640 zooplankton samples were taken at 240 stations).

1.2.4 An interdisciplinary programme designed to investigate the survival of and feeding in cod larvae was started in 1975 and continued in 1981, with special emphasis on the feeding of larvae in relation to the distribution of food organisms. An *in situ* particle rate meter has been used in the study of the small scale distribution of zooplankton organisms.

1.3. Ichthyoplankton

1.3.1 All fish eggs and larvae collected by the Institute since 1976 have been identified and recorded. This is partly a component of a biological baseline and monitoring programme preceding the planned oil exploitation programme on the shelf north of 62°N, (see 1.1.1 and 1.2.2). The recordings also go towards an increased knowledge about spawning seasons and behaviour of the larvae of different fish species. About 13 500 samples have been worked up since 1976.

2. University of Bergen.

Institute of Marine Biology

2.1 Studies in the land-locked fjord system Lindåspollene have continued, with particular emphasis on controlled experiments in plastic enclosures on the pelagic system. Parameters have been estimated for the mathematical model of the dynamics of the system, which is under verification.

2.2 Critical assessment of phytoplankton production estimates has continued. Coverage of another spring season in Korsfjorden has extended knowledge of annual variations in the timing, magnitude and composition of the spring phytoplankton bloom. Analyses of chlorophyll in water samples and in size-selected zooplankton have demonstrated the importance of larval forms (*Balanus*) as grazers during the spring bloom, while holoplankton (*Calanus*) is more effective after the bloom.

2.3 Studies are being carried out on the local distribution and composition of the zooplankton in the west Norwegian

coastal area, with the aim of estimating the extent to which plankton is advected from one water mass to another.

Department of Fisheries Biology

2.4 In a landlocked fjord, Lindåspollen, studies on eggs and larvae of herring have been continued in order to assess the stock size and the reproduction of the herring stock in the area.

3. Norwegian Institute for Water Research NIVA Oslo.

3.1 Phytoplankton

Within the framework of the National Pollution Monitoring Programme levels of Chlorophyll a has been used to indicate the degree of eutrophication in several polluted fjords. Quantitative phytoplankton samples were collected in some of these fjords.

Extensive primary production measurements (Carbon 14) coupled with automatic recording of chlorophyll fluorescence (Variosenes) have taken place in connection with baseline studies in the future recipient for petrochemical industry at Kårstø, south-western Norway.

3.2 Benthic communities

Registration of shore and shallow water communities by diving were routinely applied in recipient investigations and monitoring. Lower limit of benthic algal growth has been used to characterize the mean light conditions. Structure of soft bottom fauna have also been studied at several of the localities selected for the above mentioned National Monitoring Programme. Stereophotography at fixed sites down to 30 m took place twice a year in two fjords partly relived from pollution.

4 University of Oslo

Institute of Marine Biology and Limnology

4.1 Phytoplankton

Investigations were continued in the following areas:

4.1.1 Diatom morphology and taxonomy (G.R. Hasle, E. Syvertsen)

4.1.2 Ultraplankton flagellates (J. Thronsdén).

4.1.3 Dinoflagellate taxonomy and fine structure; red tides, (K. Tangen).

4.1.4 Carotenoids of Dinoflagellates and Euglenophytes (T. Bjørnland)

- 4.1.5 Coccolithophorid physiology (O.K. Andersen, E. Paasche)
- 4.1.6 Nitrogen turnover in coastal waters: ¹⁵N investigations (E. Paasche, S. Kristiansen).
- 4.1.7 Effects of oil pollution on phytoplankton communities (S. Kristiansen, J. Throndsen, in cooperation with staff at the University of Bergen).

4.2 Zooplankton

- 4.2.1 Description of a divided neuston sampler was published (Schram, Svelle & Opsahl, Sarsia 66 (4)).
- 4.2.2 Studies were continued on the occurrence of adults and developmental stages of the eye-maggot (Lernaenicus sprattae) of the sprat (Schram).
- 4.2.3 Morphological and biological studies were carried out on the subspecies Aglantha digitale digitale (O.F. Müller) and A.d. rasea (Forbes) in the Oslofjord (student, Beyer).
- 4.2.4 Feeding habits and enzyme polymorphism in Oslofjord populations of Thysanoessa raschii and Meganocyttiphanes norvegica were investigated (Fevolden).

4.3 Phytobenthos

Investigations were continued in the following areas:

- 4.3.1 Taxonomy and life histories of red algae (J. Rueness).
- 4.3.2 Autecological studies of algae in the Oslofjord (J. Rueness).
- 4.3.3 A survey of the distribution of Laminaria in North Norway was initiated (K. Sivertsen, J. Rueness).

4.4 Zoobenthos

Investigations were continued in the following areas:

- 4.4.1 Biological interactions (predation, competition, succession) as background noise in biological monitoring studies (J.S. Gray and collaborators).
- 4.4.2 Factors controlling community structure in a benthic community of soft-sediments in Oslofjord (J.S. Gray).
- 4.4.3 Classification and dynamics of benthic animal communities in Oslofjord (students, Gray).
- 4.4.4 Reproduction biology, population strategy, energy budget and production of various polychaetes (students, Gray, Schram).
- 4.4.5 Methodological and ecological studies of soft bottom foraminifera (students, B. Christiansen, Beyer).

4.4.6 Effects of epibenthic macropredators on community structure were studied by means of enclosure cages in eutrophicated shallow water (J.A. Berge & I.H. Hesthagen).

4.4.7 The effect of eutrophication and pollution on the structure of fish communities in the Oslofjord is currently under investigation. Also covered are aspects of the general biology of: Gobius niger, Ammodytes tobianus, Lycenchelys sarsi, Lycodes vahlii gracilis and Enchelyopus cimbrius (R.D.M. Nash, a Royal Society Fellow).

5. University of Tromsø

Museum of Tromsø

5.1 Phytoplankton

5.1.1 The monitoring of standing stocks of phytoplankton in Skjomenfjord, Northern Norway, after the building of a hydroelectric power plant (H. Chr. Eilertsen). This is part of a long-term study to assess the potential effects of regulating freshwater on the marine ecosystem in a fjord.

5.1.2 Phytoplankton species succession, abundance and dynamics of growth in Balsfjord (H. Chr. Eilertsen).

5.2 Zooplankton

5.2.1 The monitoring of standing stocks of zooplankton in Skjomenfjord, Northern Norway, after the building of a hydroelectric power plant, including the interaction of zooplankton with hyperbenthos (N. J. Sands).

5.3 Zoobenthos

5.3.1 Monitoring of hard-bottom fauna in Balsfjord, Northern Norway, with special emphasis on effect of sedimentation (B. Gulliksen).

5.3.3 Effect of pollution on benthic communities in the Tromsø area (B. Gulliksen, B. Holte, K-J. Jakola).

5.3.4 Mapping of hard-bottom communities around the coasts of Spitsbergen and Bjørnøya (B. Gulliksen, O.K. Sandnes).

Institute of Biology and Geology.

Zooplankton

Ecological studies on the zooplankton community of Balsfjorden, first began in 1976, are being continued. The life cycles and seasonal biochemical cycles of the dominant species have been

investigated. Work is progressing on examining the overwintering and reproductive strategies. This work has, where possible, been carried out with regard to relating changes and fluctuations to those of the physical environment (e.g. incident light, hydrography, particulate matter) and to those of the phytoplankton (in cooperation with the phytoplankton workers). (C.C.E. Hopkins, S. Falk-Petersen, K. Tands, S. Grønvik).

Studies of zooplankton sound scattering layers, chiefly krill (euphausiids), in North Norwegian fjords are being carried out with 38 kHz and 120 kHz echosounder coupled to a digital echo-integrator. The trophodynamic and behavioural interactions between krill SSLs and fjord fish are also being examined. (C.C.E. Hopkins, S. Falk-Petersen, F. Pettersen).

A long range research and development program was started in 1974 at the Royal Norwegian Council for Scientific and Industrial Research (SINTEF) of the University of Trondheim under the title "Havbiomodeller" (translation: 'Ocean Biomodels'). The goal of this program is to establish mathematical models of the marine ecosystem of the Barents Sea. The model consists of sub-models describing physical and chemical oceanography, growth and distribution of phytoplankton and zooplankton, and the state and migratory pattern of the main fishing stocks. A preliminary model has been developed for zooplankton; the experimental work necessary to provide appropriate data for it is being carried out in Tromsø. At present work is being focused on the ingestion and digestion sub-models, and growth rates as functions of temperature and food concentration and quality, for Calanus finmarchicus (K.S. Tande, C.C.E. Hopkins).

Fish

Research was started to examine the importance of zooplankton in the diet of capelin (Mallotus villosus) in Balsfjorden. The growth of capelin is being examined in relation to seasonal changes in the physical environment, and food quality and quantity in the fjord. (C.C.E. Hopkins, student).

Hyperbenthos

The population dynamics, production, and ecological energetics of the deep-water prawn (Pandalus borealis) is being studied in Balsfjorden. (C.C.E. Hopkins, 2 students).

Zoobenthos

Investigations on the bottom fauna of the Barents Sea and the Spitsbergen area. (E. Oug).
Population dynamics of Macoma calcarea (E. Oug, student).

Systematics and zoogeography of the Terebellomorpha (Polychaeta) (Torleif Holthe).

Investigations on the deep sea fauna of the Norwegian Sea (Torleif Holthe and collaborators).
Zoogeography of the Echinoderms of North Norway (T. Holthe, student)

Population dynamics of Pectinaria hyperborea in Balsfjorden, North Norway (T. Holthe, student).

Reproduction and larval development of echinoderms, particularly star-fishes (I.-B. Falk-Petersen).

Reproduction and larval development of sea urchins (S. Lønning Vader, I.-B. Falk-Petersen, W. Vader, 1 student).

Fish development

Fertilization and early development of marine fishes (cod, flat-fishes) are studied by morphological (including EM) and physiological methods (S. Lønning Vader, J. Sundet, E. Kjørsvik, 1 student).

6. University of Trondheim

6.1 Phytoplankton

6.1.1 Variations in growth rate and fluorescence of marine planktonic diatoms exposed to Ecofisk crude oil in outdoor dialysis cultures were studied. (E. Nøst Hegseth in cooperation with Dr. Ing. K. Østgaard).

6.1.2 Observations on the phytoplankton distribution in the Trondheimsfjord, with special emphasis on the first spring bloom, were continued. (E. Nøst Hegseth).

6.1.3 Metabolism of 3-1,3 glucans in diatoms (S. Myklestad, K. Waarum).

6.1.4 Effects on growth rate and chemical composition of Skeletonema when adapting to different light intensities and photoperiods, and the combined effect of sun/shade adaption and nutrient deficiency (E. Sakshaug).

6.2 Zooplankton

6.2.1 A report on the chemical components of Calanus finmarchicus has been prepared (L. Jørgensen).

6.2.2 Use of energy by Calanus finmarchicus (L. Jørgensen).

6.2.3 Zooplankton kept in dialysis chambers (L. Jørgensen)

6.2.4 Grazing of Calanus finmarchicus on diatoms in dialysis culture. (L. Jørgensen).

6.2.5 Carbon and nitrogen expenditure in eggs and larvae of cod (Gadus morhua) (L. Jørgensen).

6.2.6 Routine sampling of zooplankton once a month by Nansen 75/180 μ m net continued at three oceanographic stations in Trondheimsfjorden (J.-A. Sneli, T. Strømgren).

6.2.7 Methods for biochemical genetic identification of planktonic fish eggs (with special emphasis on gadoids) by diagnostic enzyme loci have been developed and applied (J. Mork, G. Sundnes).

6.3 Phycobenthos

6.3.1 Effects of heavy metals (Cu, Zn, Pb, Hg and Cd) on the shell growth of Mytilus edulis. Temperature strategies of Ascophyllum nodosum. (T. Strømgren).

6.4.2 Taxonomy and occurrence of Scandinavian and Arctic turrid prosobranchs are studied. (J.-A. Sneli, Ø. Stokland)

6.4.3 Investigations on the bottom fauna assumed to be affected by the activity of a paper pulp factory in the inner Trondheimsfjord (J.-A. Sneli, Ø. Stokland).

6.4.4 Biology of Cancer pagurus on the coast of Møre (J.-A. Sneli, G. Sundnes, A.K. Woll).

Poland

(K. Siudziński)

Sea Fisheries Institute, Gdynia

Baltic

In 1981 plankton and benthos studies were continued as follows:

1. Phytoplankton

- Study of seasonal changes of primary production and distribution of chlorophyll in the Gdańsk Bay.
- Seasonal changes of vertical distribution, abundance and phytoplankton species composition in euphotic layer of Gdańsk Bay.

2. Zooplankton

- Seasonal changes of species composition and abundance at different layers of Gdańsk Bay
- Macrobenthos
- Distribution, biomass, abundance and species composition of benthic organisms in dependence of bottom substrate,
 - energetic value of some benthic species.

In July 1981 a complex ecological survey was conducted aboard r/v "Professor Siedlecki" in the Southern Baltic

- to find out the real and existing state and the main source of pollution in the Polish economic zone;
- to attempt and to define the influence of pollution on the health of fish stocks in general and on the actual diseases in particular.

The area within the whole Polish economic zone were covered with the grid of over 100 stations by r/v "Professor Siedlecki" 9 - 29 July 1981-

The main groups of observations were as follow;

- meteorological: standard observations and diurnal mean concentration of dust
- physical and chemical oceanography: T, S, O, P nitrates, nitrites, amoni and silica, fluorine, suspended matter, transparency, organic matter and nannoseston;
- biological oceanography: chlorophyll, phytoplankton, zooplankton, ichtyoplankton, benthos and meiofauna as well as bacteria and viruses were investigated.
The outstanding preliminary result was the absence of macrobenthos and meiofauna in the deep regions /Gdańsk and Bornholm Deep/ where the oxygen contents of the bottom waters were low and H_2S was present in the bottom sediment;
- fishery research: fish biology /sprat, herring and cod predominantly/, their state of health, and stock assessment by means of hydroacoustic methods.

Sprat and herring were healthy, but cod and some other demersal species showed some signs of sickness, the nature of origin is still unknown;

- pollution research: heavy metals: Hg, Pb, Cu, Zn, Cd and others /in atmospheric dust, water, sediment and fishes/ pesticides /in the fish fat, liver and meat/ radioactive elements - Cs¹³⁷, Sr⁹⁰, Ra petroleum hydrocarbons mustard gas /sediment and fishes/ fluorine /water, sediment/

There were no traces of mustard gas and the concentration of fluorine was close to normal.

High concentrations of hydrocarbons were noted and patchiness in their distribution was observed in the coastal zone, near river mouths and big cities.

Data processing and elaboration is to be completed by the end of September 1982.

Antarctic

In 1981 r/v "Prof. Siedlecki" has participated in the BIOMASS-FIBEX PROGRAM.

The composition and biomass of phyto- and zooplankton as well as respiration intensity of some phytoplankton feeders were studied.

Life cycle of Euphausia superba and social behaviour of krill were studied on the base of previous r/v "Prof. Siedlecki" expeditions.

Agriculture Academy in Szczecin

- Biological capacity of the Baltic coastal zone
- distribution and ecology of Baltic meiofauna
- production of pelagic zone in the Southern Baltic
- Dynamic of Southern Baltic benthos biomass.

Institute of Oceanography of the Gdańsk University

Changes in the coastal biocenosis under the man-kind pressure.

- field studies at stations about 4 profiles in the Gdańsk Bay
- experimental work: influence of some physico-chemical parameters on the rate of photosynthesis of algae

In the southern Spitsbergen /Hornsund/ studies were carried out on:

- dynamic of coastal ecosystem, exchange of organic matter between sea and land,
- continuation of studies on dynamic of amphipods and their calorific value.

University of Gdańsk, Department of Plant Physiology

Growth responses of Scenedesmus quadricauda to oil pollution.

The influence of water extracts from the fuel oil L2 on some physiological processes in Scenedesmus quadricauda growing in laboratory conditions was investigated. It was stated that in the presence of oil extracts, the cell number, chlorophyll a content and biomass production markedly decreased. These effects were more distinct with the increasing concentration of extracts. A qualitative and quantitative analysis showed the presence of 14 various aromatic hydrocarbons in the investigated oil extracts.

The influence of some growth regulating substances on marine algae.

The action of exogenously applied gibberellins A₃ and A₇ on the unicellular algae Chlorella vulgaris, Scenedesmus quadricauda and Dictyosphaerium pulchellum was investigated. The algae were isolated from the natural baltic phytoplankton. In the presence of either gibberellic acid or gibberellin A₇ at a concentration of 1 mg/dm³ and 10 mg/dm³ a growth stimulating effect and promotion of biomass production was noted. It was also stated that the investigated algae may be a significant source of excretion of endogenous gibberellins into the medium. Substances of cytokinin activity were isolated from the natural sea water

collected from the Puck Bay of the Baltic Sea. The high biological activity of the isolated substances suggests their possible importance in the ecological relationships of marine organisms.

Institute of Oceanology, Polish Academy of Sciences,
Sopot.

No report received.

Portugal

(T. Neto and A. Ribeiro Cascalho)

INSTITUTO NACIONAL DE INVESTIGAÇÃO DAS PESCAS: Lisboa

Upkeep of the phytoplankton cultures stock (phytoflagellates, diatoms, dinoflagellates, chlorophyceae, development of ten to twenty litre monoalgal cultures to feed the zooplankton stock cultures.

Studies on productivity with phytoflagellates and chlorophyceae.

Studies on the nutritional value of the phytoplankton cultures.

Study of a red water in Lisbon coast May-July 1981.

Study of phytoplankton integrated in the program "Environmental study of the Tejo estuary" coordinated by Comissão Nacional de Ambiente (Ma. Teresa Moita).

Upkeep of the zooplankton cultures stock (copepods and rotifers)

Production experiments with the rotifer Brachionus plicatilis in five litre aquaria using yeasts and alive microalgae.

Development of bigger volumes of Brachionus culture (twelve to sixty litre) to give as food for Aquaculture.

Food quality experiments with Tigriopus brevicornis using microalgae and terrestrial vegetables.

Study of ichthyoplankton related with Sardina pilchardus (W.) spawning and breeding areas between Cabos Espichel and Sadao (Ma. Teresa Rodrigues and Francisca Varela).

Study on the distribution of zooplankton collected by the N.E. "NORUEGA" off Madeira island in June and November 1980.

Studies on respiration, assimilation and excretion of zooplankton in a red Water in Lisbon coast May-July 1981.

Study of zooplankton collected by the N.E. "NORUEGA" with a WP-z net along the coast of Portugal during June 1979 and March 1980 (I.de Paiva and T.Neto)

Studies on the population dynamics of three rocky intertidal species : *Patella vulgata*, *P. depressa* and *P. aspera*. In 1982, these studies will be extended on the portuguese coast (Mirian Guerra and Ma.José Gaudêncio).

Spain

No report received.

Sweden

(R.Rosenberg)

Institute of Marine Research, Lysekil

Assessment of secondary production in different shallow water habitats, i.e. sandy to clayey substrates with and without vegetation. The investigation is concentrated on the mobile epifauna and the infauna. A new device, a portable drop-trap, has been introduced. This allows quantitative sampling with high accuracy and statistically precise assessment of the fauna.

Kristineberg Marine Biological Station

Benthos

Monitoring of macrobenthos in soft sediments of the open Skagerrak and the Gullmar Fjord was continued. The project is financed and administrated by the Environment Protection Board and started in practice in 1970. Methods involve quantitative grab-sampling and the primary aim is to assess the quality state of the bottom environments. (A. Josefson).

Long-term monitoring of rocky subtidal communities on the Swedish west coast by stereophotographic recordings of permanent test areas continues since 1969. Population dynamics and regulating mechanisms was studied in detail for some ascidian populations. Manipulative field experiments concerning recolonization rates in different environments and the effects of predation were carried out. (T. Lundälv and collaborators).

Plankton

The plankton activities at Kristineberg have been concentrated at a monitoring programme on phyto- and zooplankton on the Gullmar Fjord (Swedish west coast). Special attention has been paid to the extraordinary heavy dinoflagellate blooms which have occurred almost every autumn in recent years. A separate project has studied marine rotifers and their role in the pelagic ecosystem. (L. Hernroth, O. Lindahl).

Department of Ecological Zoology, University of Umeå

The research program of the Department include the following topics:

Interrelationship between coastal streams and adjacent coastal areas in the northern Bothnian Sea. Long-term investigations of physical and chemical factors, microorganisms (algae and fungi), invertebrates (adaption of several limnic insect groups to the oligohaline brackish water) and fishes (seasonal occurrence and migrations) in the northern Baltic.

The ecological significance of biological rhythms, temporal programs and photoperiodism in the life of the Baltic Salmon. Environmental influence on behaviour and life history tactics in different populations of Mesidothea entomon in the northern Baltic. Morphological changes in the fish skeleton by water pollution in the Gulf of Bothnia.

University of Lund, Department of Marine Botany.

1. Macroalgae

Primary production, growth rate, biomass, limiting factors, bioaccumulation of N-P, Cu, Zn, Pb and radionuclides. 5 scientists.

2. Microbenthic algae

Primary production, biomass, species composition, grazing effects. 1 scientist.

3. Phytoplankton

Arctic primary production and species composition
Successions and red tide phenomena in Swedish marine waters
Bioassay studies of limiting nutrients
Taxonomic revision of some Diatomea genera.

University of Gothenburg, Department of Zoology

Invertebrate taxonomy : Mollusca (Gastropoda), Oligochaeta, Polychaeta, Nemertina, Foraminifera

Ecology : Factors affecting population regulation in (marine) ducks
Reproductive strategies/population dynamics in certain polychaetes
Development of methods for the use of polychaetes in bioassay research
General ecological studies on certain groups of Gastropoda, Foraminifera, Nemertina

Effects of chemicals on aquatic organisms

Development of methods to measure effects of chemicals on aquatic organisms

Comparative and general physiological studies on marine fishes

United Kingdom

1. England

(D.J. Garrod)

1. MAFF Lowestoft Fisheries Laboratory

The only major plankton surveys undertaken by MAFF Lowestoft in 1981 were in the English Channel, to investigate the distribution and abundance of the eggs and larvae of sole (Solea solea), sprat (Sprattus sprattus) and bass (Dicentrarchus labrax). Three surveys were completed between April and June and on the first of these, artificially fertilised sprat eggs were successfully reared to hatching over the range of temperature 4.5°C to 20°C. The results of this experiment were reported to ICES in 1981, CM. H:15.

A 2 m wide neuston frame net was successfully used to capture large mackerel larvae, up to 35 mm long, at the surface in the Celtic Sea and western English Channel in June. These large larvae are not normally sampled quantitatively by the standard plankton samplers.

A survey with the 50 cm high speed plankton sampler was made in the mackerel spawning area of the Celtic Sea shelf edge. This survey was done in collaboration with the Institute for Marine Environmental Research (IMER), Plymouth who used the undulating oceanographic recorder (U.O.R.), over selected parts of the survey area. This exercise was done to begin the evaluation of the U.O.R. sampling method for large scale surveys of egg abundance for stock assessment purposes. The U.O.R., which can be towed at up to 20 knots, integrates a small sample down to 100 metres, over a continuous horizontal transect, compared with the single point samples integrated over a maximum of about 10 kilometres taken by a standard high speed sampler. Thus the U.O.R. method has the potential to reduce both collecting time, and sample size, with a resultant overall saving in costs.

One survey of the plaice egg patch in the southern North Sea was undertaken in January 1981. The spatial and vertical distribution of newly spawned plaice eggs was examined in relation to the behaviour of the adults.

Analysis of samples and physical data collected in the vicinity of both the Flamborough 'front' (northeast coast of England) and the Celtic Sea shelf edge, front continues. These data are being reviewed in relation to the importance of 'frontal' processes to commercial fisheries.

Herring and sprat larvae abundances were assessed from the ICES coordinated surveys of the eastern English Channel and southern North Sea in January and February, and from the central North Sea in September and October.

Two plankton surveys over the 'Nephros' spawning grounds in the western Irish Sea will be undertaken between April and June 1982. These samples will be used to attempt to assess adult stock size from the abundance of 'nephros' larvae. The opportunity will be taken to collect biological and physical data in the vicinity of the western Irish Sea front.

The HIAC particle size analyser has been developed for continuous monitoring of particle size at sea. This equipment is used to support frontal zone studies and can also be used in the laboratory for fecundity estimates.

Both the Lowestoft 76 cm and 50 cm diameter high speed plankton samplers are being redesigned to incorporate conical nose cones, a larger net and improved electronic flowmeters based on the "Braystoke" propellor modified to take a "Hall effect" pick up. The underwater monitoring unit on the new sampler will be an 'in house' modified "Guildline Arctic C.T.D.". This unit will provide a deck read out of the internal and external flowmeter revolutions, the flowrate and the ratio between them, in addition to continuous profiles of temperature, salinity, dissolved oxygen and pH.

Institute for Marine Environmental Research, Plymouth

1. The Continuous Plankton Records Survey

The survey by the Continuous Plankton Recorder was continued on the same basis as in previous years. Recorders were towed at a depth of 10 m at monthly intervals along the standard routes shown in Figure 1. During 1981 Recorders were towed 91,383 miles by 20 ships of eight nations (Denmark, France, Iceland, Netherlands, Norway, Republic of Ireland, Sweden and the U.K.). The CPR survey began in 1931 with three routes in the southern North Sea. Since 1948 the plankton has been collected, analysed and the results processed in the same way. An inventory of the survey is produced every year and is available, on request, to the Director, Institute for Marine Environmental Research, Prospect Place, The Hoe, Plymouth, PL1 3DH, U.K. Details of data processing procedures are given by J.M. Colebrook in Bull. mar. Ecol., 8, 133-142.

2. Undulating Oceanographic Recorder

The Undulating Oceanographic Recorder (UOR) has been towed regularly between Plymouth and Roscoff (PR route - see Figure 1) by MV Cornouailles (by kind permission of Brittany Ferries). The UOR is a self-contained oceanographic sampler which can be towed by "ships-of-opportunity". It carries instrumentation to sample plankton continuously, and to measure chlorophyll (range 0 to 100 mg m^{-3}), radiant energy (range 0 to 1000 $\text{u E m}^{-2} \text{ s}^{-1}$), temperature (range 0 to 30°C) and salinity (range 32 to 37‰), all of which are recorded, with the measurement of depth, by a miniature digital tape recorder with a resolution of 0.1% of full scale.

3. Fish eggs and larvae

IMER collaborated with MAFF to study the distribution and abundance of eggs and larvae of plaice in the southern North Sea and mackerel in the south-western approaches in relation to their physical and biological environment.

2. Scotland

(R. Jones)

1. Marine Laboratory Aberdeen

Scyphomedusae

Scyphomedusae were collected, as in previous years, during the International O-group gadoid survey in the North Sea. Estimates of abundance and distribution of the commoner species, Aurelia and Cyanea, have been derived and compared to those in earlier years.

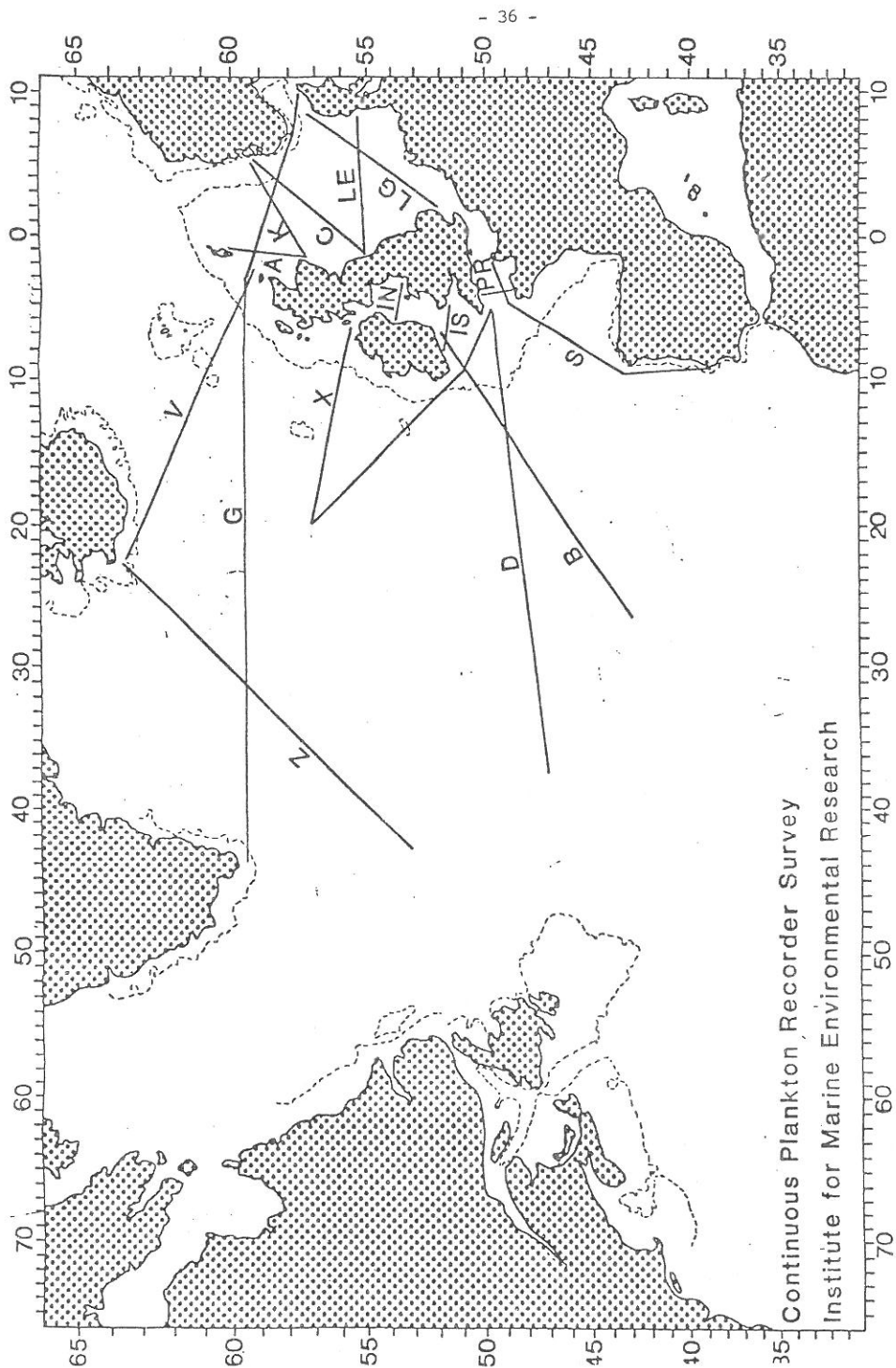


Figure 1 The Continuous Plankton Recorder Survey 1981. The routes are identified by code letters.

Enclosure experiments

In 1981, the Loch Ewe enclosures were used to investigate four problems:

- a) the chemical and biological changes occurring during the growth and collapse of a spring bloom. Changes in the organic chemistry (lipid, carbohydrate and protein) of the water and particulate matter were related to changes in the inorganic nutrients in the water. The succession of biological changes in the water column (phytoplankton - bacterioplankton - zooplankton) was studied as the bloom developed and decayed.
- b) an enclosed body of water was used to follow in situ and in vitro (incubation bottle) oxygen changes for a diel cycle. The gross primary production measured by oxygen changes in the incubation bottles was compared, using an appropriate PQ with primary production measured using the C^{14} technique. The agreement between the in situ and a vitro oxygen values were excellent and there was a close agreement between primary production measured by the oxygen and C^{14} techniques.
- c) the enclosures were also used in 1981 to investigate the problems of rearing cod from eggs, and to test the survival and feeding of cod larvae in large enclosures. This work was carried out so that further large scale experiments with cod larvae may be run in 1982.
- d) several potential causes of the very high initial hatching mortality of herring larvae which has been a feature of all previous herring larval experiments, were investigated. None of the features studied, including oxygen levels in the water, handling and plating density was found to be the cause of the initial very high mortality.

Theoretical studies of energy flow through food webs

Further work has been done on the simulation of primary production and of energy flow through simple food webs.

Summer production studies east of Orkney

Hydrographic, chemical and biological studies were once again undertaken during the summer in the area East of Orkney in order to assess annual changes in the productivity of that area.

2 Dunstaffnage Marine Research Laboratory, Oban (SMBA)

Deep-sea studies on the Rockall Trough and Porcupine Sea Bight.

The seasonal sampling of the demersal fish populations at two deep stations in the Rockall Trough and at two transects in the Porcupine Sea Bight continued during 1981. The macro and megabenthos at the two SMBA permanent stations in the Rockall Trough

was sampled during the year and the main emphasis was on the growth and reproduction of the echinoderm populations. The meio-benthos programme in the Rockall Trough, Porcupine Sea Bight and the Porcupine Abyssal Plain continued in collaboration with microbiologists from a number of institutes.

U.S.A.

(K. Sherman and G.D. Grice)

Fisheries Ecosystems Investigations

An energy budget for Georges Bank was completed by the staff of the Northeast Fisheries Center based on original data and a review of the published literature. Primary productivity of Georges Bank is extremely high ($450 \text{ gC} \cdot \text{m}^{-2} \cdot \text{yr}^{-1}$ or $2.97 \times 10^7 \text{ J} \cdot \text{m}^{-2} \cdot \text{yr}^{-1}$), apparently reflecting the rapid regeneration of nutrients on the bank unimpeded by a thermocline and the advection of nutrients from deeper waters on both sides of the bank. Zooplankton production based on biomass and a P/B ratio of 7 is estimated as $1.46 \times 10^6 \text{ J} \cdot \text{m}^{-2} \cdot \text{yr}^{-1}$ ($350 \text{ KCal} \cdot \text{m}^{-2} \cdot \text{yr}^{-1}$). Macrobenthos production is estimated at $7.53 \times 10^5 \text{ J} \cdot \text{m}^{-2} \cdot \text{yr}^{-1}$ ($180 \text{ KCal} \cdot \text{m}^{-2} \cdot \text{yr}^{-1}$) between the period 1964-1966 and 1973-1975. Georges Bank appears to be more productive per unit area at all trophic levels than the North Sea which is a much larger area. The difference in productivity is greater at lower trophic levels than for finfish and squid, possibly as a result of advection off Georges Bank.

Competition among groundfish and pelagic fish: Several studies by the NMFS Woods Hole Laboratory were completed on factors affecting the food and feeding patterns (e.g., size of predator, diet in relation to time of day, area and season) of major fishes on the continental shelf off the northeast United States. These included diet overlap of principal fish predators on Georges Bank and adjacent New England waters, distribution and food of 0-group (young-of-the-year) fish, and the role of mouth structure on feeding ecology of flounders. The importance of silver hake as one of the principal fish predators on Georges Bank was confirmed, and a detailed study of diet vs. size of silver hake was completed. In addition, estimates of daily ration and gastric evacuation rates for winter flounder were obtained from aquarium experiments.

Ichthyoplankton: The effect of variability of MARMAP egg densities over space and time was examined in relation to egg abundance estimates. Based on the results of ichthyoplankton surveys conducted during the spring and summer of 1977 and 1979 off northeastern United States, it is shown that with bimonthly surveys, adequate estimates of total seasonal egg production can be made for three species. For these species, egg production curves appear to be fairly smooth over time with peak production lasting a month or longer. The smoothness of the production curves is the major reason why cruises which are widely

spaced, with respect to the life span of eggs, produce estimates.

The MARMAP plankton surveys of the Northeast Fisheries Center provided the initial evidence of a recent and significant change in the ichthyofaunal structure off the northeastern United States. Immediately following an 8-year period of heavy fishing pressure and a 50% decline in fish biomass, the surveys produced evidence of a population explosion of sand lance larvae. Abundance estimates of larvae during the February-March time period increased from a low of 490×10^9 in 1974 to a high of 9640×10^9 in 1979. The estimates for 1980 dropped sharply to 1690×10^9 but increased again in 1981 to 5160×10^9 . With the exception of 1976 when the center of their distribution was on Georges Bank, larval sand lance have been most concentrated off New York and Southern New England where large patches exceeding 1000 larvae/10m² surface area have extended for distances exceeding 300 km. Evidence from other MARMAP activities (i.e., trawl surveys, diver observations and food habits studies) indicates that adult populations of sand lance have increased sharply since 1976.

Commensurate with the increase in sand lance larvae, we have observed a downward shift in the abundance of Atlantic herring larvae on Georges Bank and around Nantucket Shoals, the principal spawning grounds during the 1960's and early 1970's. Since 1976, production of herring larvae has dropped significantly in these two areas. Autumn and winter surveys in 1980-81 failed to produce a single herring larva on Georges Bank. Preliminary observations of samples collected during autumn 1981 surveys indicate that herring larvae were again absent on the Bank.

The fifth consecutive year of intensive MARMAP plankton surveys was completed by the survey group at the NMFS Sandy Hook Laboratory, New Jersey. Eight surveys were conducted to measure seasonal and annual variability of primary productivity (¹⁴C), chlorophyll a, nutrients (NO₃, NO₂, SiO₃, NH₄, and PO₄), zooplankton, ichthyoplankton, seabirds and water column temperature, salinity, dissolved oxygen and circulation. In addition to plankton-fish linkage studies, information on fish eggs and larvae is used to derive fishery-independent estimates of adult spawning biomass. In 1981 a population estimate was made for yellowtail flounder. Work in progress includes biomass estimates for silver hake, sand lance, haddock and bluefish.

Taxonomic guides: The "Guide to the early stages of marine fishes occurring in the western North Atlantic Ocean (with emphasis on shelf and slope species found between Cape Hatteras and the southern Nova Scotian Shelf)" by Michael P. Fahay, of the NMFS Sandy Hook Laboratory, has been completed and sent out for final review. After incorporation of reviewers' suggestions, the guide contains descriptions of eggs and larvae of 300 species contained within 106 families and also includes several summary sections which allow comparison of confusing species-pairs or groups.

Warm Core Ring study: A study of Warm Core Rings was begun by the Northeast Fisheries Center, Woods Hole Laboratory, in cooperation with a National Science Foundation funded project

involving investigators from several universities and institutions. The primary goals of the study are to evaluate the entrainment of shelf water induced by the rings as a source of larval mortality and the ability of remote sensing techniques to estimate this entrainment. Accomplishments include a preliminary cruise studying ring entrainment (Albatross IV 81-11), cooperation with the Soviet research vessel Stvor in a survey of the Slope Water region through which the rings pass, and the test of a satellite communication system (AIS) to transfer data and voice between ships and ship-to-shore.

Currents: Analysis of existing data sets was continued by the MARMAP oceanographic unit at Woods Hole. Analysis of the current meter data from the Northeast Channel and Patch Study moorings was completed and manuscripts for publication are nearing final form. The analysis of a Flux Line data set in the vicinity of Nantucket Shoals yielded two interim reports. In addition, circulation data was pooled with other investigators from WHOI, University of New Hampshire, and U.S. Geological Survey, who have worked on Georges Bank to prepare a manuscript describing the mean circulation on the Bank.

RNA-DNA indicators of larval fish health: Larval and juvenile cod, haddock, and sand lance collected at sea were analyzed by the Larval Physiology group at the NMFS Narragansett Laboratory, for ribonucleic acid (RNA), deoxyribonucleic acid (DNA) and protein. The larvae of all three species had consistently high RNA-DNA ratios indicating good condition and rapid growth. Based on laboratory studies of the relationship between growth rate (% increase in protein content per day) and RNA-DNA ratio they would be expected to be growing at the rate of 14% per day. The group also participated in a cooperative study with the Fish and Wildlife Service Columbia National Fisheries Research Laboratory on the effects of existing contaminant burdens on the viability of striped bass from east coast rivers. Laboratory reared and field caught larvae were tested for swimming stamina and biochemical condition. Adult sand lance were collected during the second week of November from the lower Merrimac River Estuary spawned one month later in the laboratory. Data on fecundity, development at four temperatures, hatching size, and larval growth are being collected. A study of the effects of water temperature during the latter stages of oogenesis showed

that growth, the timing of yolk absorption and first feeding of flounder larvae were related to acclimation temperature. Starvation and refeeding studies with larval winter flounder showed that the recovery period was much longer than expected. Summer flounder spawned in the laboratory were used for studies of viability, cryogenic preservation of sperm and aging.

Larval herring: Considerable effort was devoted to final analysis and summary of the 1971-1977 ICNAF larval herring time series for the Georges Bank region by the NMFS staff at Woods Hole. Reports were prepared on ichthyoplankton abundance, community diversity, spatial pattern over the seven year time series, larval herring growth and mortality estimates, and zooplankton abundance and composition in relation to larval herring food habits for three of the years. Work continued on

processing and analyzing the larval herring patch study on Georges Bank.

NEFC scientist also completed two multidisciplinary, process-oriented cruises in spring on Georges Bank concentrating on the growth and feeding dynamics of larval gadids. A large patch of haddock and cod larvae was located on the southeastern part of Georges Bank and special electronic sampling gear and real-time data processing methods permitted broad spectrum, discrete vertical sampling of one of the most extensive concentrations of fish larvae observed to date. During late spring when the water column becomes thermally stratified on the southern flank of Georges Bank, fish larvae and their copepod prey were both concentrated in and above the thermocline. When a storm event destroyed the thermal structure of the water column, the concentrations of fish larvae and their prey were dispersed, leading at poorer feeding conditions. The effect of spring stratification and its effect on biological productivity and larval growth and survival are being studied. All bottle samples from the cruise were processed for zooplankton identification and enumeration and were stored in computer data files for analysis of the fine scale distribution of larval fish prey organisms.

Zooplankton biomass: During 1981 studies were initiated by the NEFC staff at Narragansett on the variability in the zooplankton component of continental shelf ecosystems. Preliminary results suggest that the populations off the northeast coast of the United States have not changed significantly during the past half-century. The species that dominated the zooplankton in the 1930's remain the dominant zooplankton types in the late 1970's. Contemporary measures of zooplankton biomass levels measured as displacement volumes per 100 m³ of water sampled appear to fluctuate between years and among shelf coastal areas at the same levels of variability measured in the 1930's. From these observations it appears that the lower end of the food chain off the northeast coast shifts in species abundance observed during the 1970's seem limited to the effects of fishing mortality on adult and juvenile fish stocks at the higher end of the food chain.

At Narragansett, final work was completed on wet volume to dry weight relationships to determine the reliability of expressing biomass as displacement volume and to allow conversion between biomass measures for different areas and seasons. Preliminary studies of utilization by herbivores of autotrophic production were completed and reported to ICES. Microzooplankton sample analysis was initiated and a completed series of plankton pump samples were subjected to analysis in conjunction with multidisciplinary studies in areas of larval cod and haddock spawning. Initial examination of data indicates marked vertical structure of naupliar stages of Calanus finmarchicus and Pseudocalanus minutus in the water column. Work was begun on a guide to early developmental stages of microzooplankton. Intensive zooplankton sampling on Nantucket Shoals was carried out over a ten-day period in conjunction with NASA and Brookhaven

and Bigelow Laboratories in a study by remote sensing of phytoplankton distribution in coastal upwelling regions and the associated zooplankton abundance and distribution. Large numbers of Calanus finmarchicus were found in areas of upwelling as were planktivorous right whales. Plankton pumping was continued as a component of the larval fish and prey microdistribution studies on Georges Bank during cod and haddock spawning.

Micronekton: Studies during the year were initiated on the effects of micronekton as predators on larval fish. These studies will be conducted in cooperation with the Woods Hole Oceanographic Institution. Among the groups to be studied are the euphausiids, coelenterates, and squid larvae.

Antarctic superswarm of krill: Staff scientists of the Northeast Fisheries Center participated in studies of micronekton in the Antarctic on board the R/V Melville in cooperation with the Scripps Institution's NOAA/NSF contribution to the international BIOMASS (SCOR/SCAR) study of the productivity of the Antarctic ecosystem. Using Hydroacoustic and net-capture methods, they observed a large concentration of euphausiids in the vicinity of Elephant Island estimated at five to six million metric tons. As part of the international BIOMASS program staff personnel supervised the publication of 16 handbooks describing standard methodology for measuring the key Antarctic populations and their environments.

Plankton sorting: The Plankton Sorting and Identification Center in Szczecin, Poland, continued to process zooplankton samples for NMFS. A total of 4,000 samples collected during NMFS MARMAP surveys off the northeast coast, in the Gulf of Mexico, and from the Gulf of Alaska and East Bering Sea, were sorted for fish eggs, fish larvae, crab larvae, squid larvae, and zooplankton species.

Image Analysis System: The utility of a prototype high speed electronic imaging system for counting and sizing zooplankton was demonstrated. The study was conducted in cooperation with NOAA's Office of Technical and Engineering Services and the University of Rhode Island's School of Engineering and Graduate School of Oceanography. The prototype system is significantly faster than the traditional manual methods currently employed at oceanographic and fisheries research laboratories.

NEFC cooperative studies: Scientific exchanges were continued in a cooperative study between the Sea Fisheries Institute (MIR) in Gdynia, Poland, and the U.S. Northeast Fisheries Center to investigate seasonal variation in the phytoplankton communities of Georges Bank and the Gulf of Maine relative to the spawning times of fish stocks. This complements an ongoing study of the abundance and distribution of phytoplankton on the northwest Atlantic continental shelf on MARMAP survey cruises, the samples from which are processed at the Sandy Hook Laboratory, NJ, and at Old Dominion University. Chlorophyll a was sampled on multidisciplinary cruises in areas of larval cod and haddock concentrations on Georges Bank. In May of 1980 during a cooperative cruise with scientists from ₃AtlantNIRO, U.S.S.R., chlorophyll a values were low ($<1 \text{ mg} \cdot \text{m}^{-3}$) in the Schoal well-mixed re-

gion (40-50 m) of the Bank where the larvae were concentrated. During late April 1981, when stratification of the water column was beginning in water of 60 m or deeper, netplankton chlorophyll *a* ($>20 \mu\text{m}$) was highest near bottom and sparse in the upper water column, while nannoplankton was uniformly low. This appeared to mark the end of the spring bloom when the change from large diatoms and dinoflagellates to smaller species characteristic of the late spring--early summer community occurs. Simultaneously, young larval cod and haddock eggs were abundant in net tow samples from stations of approximately 60-70 m depth. Further study in 1982 should shed more light on the timing of phytoplankton-zooplankton larval fish cycles in spring on Georges Bank. Preliminary assessment of the $<10 \mu\text{m}$ fraction of plankton on Georges Bank is planned for spring 1982 in a cooperative study between the Narragansett Laboratory and WHOI. Samples will be taken to examine vertical profiles of bacterial populations, hetero and photo-flagellates, and ciliates. An attempt will be made to estimate standing biomass for the microbial community.

Benthic monitoring: Urban wastes of 60 million Americans are being dumped into the New York Bight area. As part of a continuing assessment on the impact of urban waste disposal on the shelf ecosystem, the Marine Ecosystem Division has been monitoring changes in the species composition and abundance of the benthos on fish production in the region. A comprehensive description of the biomass and species composition of the macrobenthic invertebrate fauna of the Middle Atlantic Bight region was published in 1981, and considerable progress was made on a comparable report for the New England region including Georges Bank and the Gulf of Maine. Also, a paper was published on the amphipods (an important food of fishes, particularly juveniles) of Georges Bank, and a detailed report was completed on the macrobenthic fauna of the "mud patch" region of the continental shelf off Martha's Vineyard and Nantucket Shoals. These reports fill a critical need for quantitative baseline information necessary for benthic productivity studies and environmental sensitivity analyses used in NEFC modelling and environmental impact studies.

NMFS Beaufort, NC, Laboratory: During 1981 larval fish research at the Beaufort Laboratory, Southeast Fisheries Center of the National Marine Fisheries Service, continued with both field studies and laboratory experiments on the growth and survival of two sciaenid and two clupeid species. Field studies were conducted in the northern Gulf of Mexico aboard the R/V Oregon II from Cape San Blas, Florida, to Galveston, Texas, with the major transect being off the Mississippi River delta in cooperation with NOAA's Atlantic Oceanographic and Meteorological Laboratories (Miami). Sampling and analyses were directed to evaluate the impact of pollutants in the Mississippi River plume on larvae of Brevoortia patronus, Micropogonias undulatus, and Leiostomus xanthurus and their food supply. Both bongo nets

and MOCHNESS (multiple opening and closing net system) were employed to sample larvae and zooplankton at depths to 100 m both day and night. Fish were examined to determine food preference

and age. A manuscript on age and growth of Atlantic croaker, M. undulatus, is in press, and a similar manuscript on spot is in review as a result of studies off North Carolina. In this past year there was initiation of investigations on the diets of species of zooplankton which have been shown to be important prey items for larvae of the above fish species. Further analyses of stable carbon ratios were conducted on components of the planktonic food web in the northern gulf in conjunction with larval fish feeding studies to evaluate the importance of terrestrial organic matter as a source of carbon in their food web. These analyses demonstrated that terrestrial carbon dropped out of the water column within 26 km of shore off the Mississippi

River and that phytoplankton served as a carbon source directly for larval gulf menhaden, whereas zooplankton was the intermediate link between phytoplankton and larval croaker, spot, and white mullet (Mugil curema). On the December 1981 cruise, ship-board feeding experiments were conducted using lab-spawned and reared gulf menhaden and spot 1 to 3 weeks of age to observe food preferences and feeding rates and to evaluate the effects of net collection procedures on the fate of soft-bodied prey such as tintinnids in larval fish guts. Laboratory studies describing morphological indicators of starvation, time to starvation at different temperatures, and growth rates of early larvae continued with spot and began with gulf menhaden. To conduct studies with live gulf menhaden larvae, we developed techniques to transport adult spawners from the Gulf of Mexico and induce spawning in the laboratory to produce a predictable supply of eggs and larvae. Chaetognaths associated with ichthyoplankton collections off North Carolina taken in 1979 and 1980 have been sorted, identified, and measured and their role as larval fish predators is being examined. Laboratory and in situ field studies to evaluate otolith daily aging techniques on larvae are continuing for scianids and Brevoortia.

NMFS Miami, Fl, Laboratory: The Miami Laboratory, Southeast Fisheries Center, conducted an ichthyoplankton cruise in the Gulf of Mexico from August 13-September 2, 1981. The purpose of the cruise was to collect tuna, scombroid, and other important commercial and recreational fish larvae for studies on development, abundance, and distribution. The material was collected using bongo and neuston nets from the R/V Oregon II. The samples were sorted by the Polish Sorting Center and the bluefin tuna larvae have been enumerated for stock size determination which will be reported to ICCAT in 1982. A total of 76 stations were made throughout the Gulf of Mexico. The Miami Laboratory is also conducting ichthyoplankton studies in the area of the Flower Gardens Reef off the Texas coast in the Gulf of Mexico. The goal of the research is to assess the impact of drilling mud plumes on the ichthyoplankton and possible effects on recruitment pathways of larval fish recruits to the reefs. Sampling has taken place in 1980 and 1981 and will be continued in 1982. Sorting is done by the Polish Sorting Center. The density of ichthyoplankton in the vicinity of the reefs ranges from 73 larvae to 383 larvae per 1,000 m³ of water sampled. Dominant

juveniles of larval fish are Gobiidae, Myctophidae, Bothidae, Carangidae, Gadidae, Bregmacerotidae, and Gomostomatidae.

Plankton Ecology Investigations

A time series investigation of Gulf Stream Core Rings is being conducted by scientists at Woods Hole Oceanographic Institution and twelve other marine institutions. This program consists of highly integrated components which include physical, chemical, and biological investigations and modelling studies. These components are designed to provide information on the structure of rings and exchange mechanisms at ring boundaries, on their marine chemistry, and on the environmental controls of biological activity of selected constituents associated with warm core rings. This research is being conducted by approximately two dozen investigators.

An intensive temporal and spatial sampling effort is being conducted to examine the changes in warm core ring biota with time, the interaction between communities of different origins in the ring transition regions, and the impact of rings on the slope and shelf water biota. In order to obtain cross-sections of species distribution, abundance and variability at specific locations, repeated sampling of the ring core and the transition areas is being done using opening/closing midwater trawls and water bottles. Component projects are focusing on the midwater fishes (myctophids, gonostomatids, and sternoptychids) and the zooplankton (euphausiids, molluscs, and copepods), the biomass of both the macrozooplankton and that portion of the microzooplankton collected by 64 μ m net, distribution and abundance.

Initial differences between ring and surrounding waters which diminish with time permit investigators to follow the evolution of processes such as silicon and nitrogen cycling in a parcel of water which can be followed with certainty over time. The composition of the herbivore population and feeding potential will change as physical parameters (e.g., water temperature) and biological features (e.g., predation pressure, phytoplankton cell size and quality) change with ring decay. Numerous aspects of zooplankton physiology (e.g., ingestion, respiration, egg production, and growth) are being monitored for certain dominant copepods and possibly euphausiids. If other zooplankton groups become numerically important, attempts will be made to study these too. Measurements of zooplankton (including some microzooplankton) processes are being made both in situ and in shipboard incubators using natural particulate material.

State of the art isotopic techniques are being employed to determine the rates of silicon, nitrogen, phosphorous, and carbon incorporation by phytoplankton. The nutritional sufficiency of the environment is being assessed. Studies of elemental cycling will permit characterization of the nutrient fluxes within the ring, across the thermocline at the ring center, and to a lesser degree across the ring-slope water interface.

At Woods Hole Oceanographic Institution work continues on the ecological and evolutionary importance of dormancy in marine

zooplankton, especially in the calanoid, Labidocera aestiva. Comparing diapause response between Florida and Woods Hole populations differed and suggests that genetic differences exist between them.

Plankton investigations at the Graduate School of Oceanography, University of Rhode Island, include work on bacterioplankton, phytoplankton, and zooplankton. The biomass and division rates of bacterioplankton have been measured at sea, in Narragansett Bay and at the Marine Ecosystems Research Laboratory. The relationship of bacterial biomass and division rates to the production of dissolved and particulate carbon, and to the grazing rates of ciliates and flagellates is being studied. Work on

phytoplankton community succession in Narragansett Bay has continued a 20-year tradition of a weekly sampling program. This has been combined with laboratory studies and computer models to analyze reasons for observed seasonal cycles. Growth rates of dinoflagellates at sea and in Narragansett Bay have continued with emphasis on the New England red tide dinoflagellate, Gonyaulax tamarensis, and on oceanic species in the genera Ceratium and Pyrocystis. Investigations of in situ growth rates, bioluminescence, phosphate and nitrogen kinetics, vitamin requirements, dinoflagellate toxins, and heterotrophic capabilities have been carried out. Studies of the biology of diatom resting spores has continued. The relationships between the plankton cycles and the benthic recycling of nutrients has continued at the Marine Ecosystems Research Laboratory, along with studies of how increased eutrophication affects community structure and metabolism. The bioluminescence of oceanic zooplankton has been examined, with emphasis on larvaceans, tunicates and ostracods as well as dinoflagellates. Analyses of copepod swimming rates and characteristic patterns of movement during grazing are being related to pollutant concentrations and to the presence of dinoflagellate toxicity and bioluminescence. The distribution of benthopelagic zooplankton in the deep sea are under investigation.

Plankton research at the Marine Sciences Research Center, SUNY Stony Brook, has involved: 1) hydrogen production and consumption by the pelagic cyanobacterium Trichodesmium, 2) the taxonomy and importance of small forms (ca. 1 to 2 μ m diameter) of phytoplankton in Great South Bay and adjacent waters, 3) photosynthetic rates, species composition and nitrogenous nutrient uptake by phytoplankton in a south shore estuary, 4) N_2O production by phytoplankton, 5) tidal mixing, fronts, and their relation to phytoplankton and zooplankton distribution in Long Island Sound, 6) food and feeding by euphausiids in the Bering Sea, 7) natural selection of resistant microbes to pollution stresses, 8) growth rates of bacterioplankton in coastal waters, 9) importance of microzooplankton grazing in coastal waters, 10) distribution of Gonyaulax tamarensis in Long Island waters, 11) larval fish feeding processes in Long Island Sound, 12) distribution and production of phytoplankton in relation to fronts in New Zealand waters, 13) adaptations of copepods to pollutant stress.

Plankton research at Brookhaven National Laboratory includes ecosystem studies of a variety of coastal habitats coordinated

with laboratory experimentation to provide the basis for predictive models of food chain dynamics of the New York and Middle Atlantic Bights. Research on phytoplankton is attempting to determine the influence of estuarine nutrient transport on phytoplankton-mediated carbon fluxes in the coastal zone and to quantify the environmental regulation of growth and light utilization efficiency of phytoplankton populations in coastal plumes associated with major estuaries along the coastal boundary of the Middle Atlantic Bight. Field observations emphasize variations in the areal influence of estuarine nutrients and particulate matter on the productivity of phytoplankton populations. Research on zooplankton has shown that there are important differences in the feeding behaviour, egg-production rates, and foodstorage abilities of the 8 numerically dominant coastal copepods. Since the rates of physiological processes of individuals *in situ* are primarily dependent on temperature and food effects and food effects are complex because both food quantity and quality play a role, laboratory and field studies of physiological processes have been pursued in an attempt to understand population fluctuations of coastal zooplankton in the New York Bight.

At Lamont-Doherty Geological Observatory phytoplankton distribution is being studied in the Middle Atlantic Bight; analysis of chlorophyll *a* data and physical parameters from the shelf edge front will be used to establish the degree to which physical phenomena at fronts control the distribution of phytoplankton. Over the continental shelf, emphasis is on the fate of primary production and the implication grazing, fecal pellet production and particle decomposition have on overall transport and transfer rates of particulate material. A separate project will characterize benthopelagic zooplankton communities in selected submarine canyons off the eastern seaboard and compare these communities to those found over the adjacent continental slope. Other zooplankton studies include projects on the physiology, life history and general ecology of the radiolaria, with emphasis on their symbiotic relationships with dinoflagellates and one on planktonic foraminifera with emphasis on environmental factors influencing shell composition, morphology, and the role of symbionts in shell deposition and reproduction. Microbiological research is concentrated on documenting bacterial abundance, biomass and production in estuaries, river plumes and the continental shelf of the Middle Atlantic Bight. Emphasis is on specifying relative distributions of free versus attached bacterial cells and their respective activities.

The main objective of the plankton research at the Skidaway Institute of Oceanography during 1981 was to determine the frequency of summer Gulf Stream upwellings on the northeastern Florida shelf and the development and fate of plankton assemblages in and near these upwellings. This was accomplished by a concerted effort of biological, chemical, and physical oceanographers using simultaneously two vessels to track water masses over several weeks during July and August. Current meter arrays between Daytona and Savannah provided data on water circulation. On-board zooplankton feeding studies provided information on zooplankton ingestion in these intrusions of cold Gulf Stream water. We continued our cinematographic studies on copepod feeding and distinguished two different modes of feeding on small and large particles.

At the University of Miami's Rosenstiel School of Marine and Atmospheric Science, the ecological genetics and comparative physiology of a wide range of phytoplankton species are being examined. Of prime interest is the extent to which populations and species are able to adapt genetically to different environmental regimes. A detailed investigation of the interaction of ecological and evolutionary processes in dinoflagellates in subtropical lagoons is being initiated. Laboratory and field studies of inorganic nutrient assimilation (SO_4^{2-} , NO_3^- , NH_4^+ , PO_4^{3-}) in marine phytoplankton focus on synthesis of major biopolymers, especially protein, at the base of the food web. Particular attention is directed towards daily cycles of synthesis and the influence of trace metals on phytoplankton growth. Investigations continue on the physiology and ecology of ctenophores and chaetognaths from South Florida and Caribbean waters. Laboratory experiments are concerned with the effects of food concentration and patchiness on rates of growth and mortality and on fecundity. A field program is examining prey selection and rates of feeding in species of carnivores not easily maintained in the laboratory.

U.S.S.R.

(A.A. Elizarov)

Barents and Norwegian Seas

To find out the food resources for commercial fishes, a winter assessment of euphausiid abundance in the Barents Sea was undertaken in 1981. Peculiarities of zooplankton development and distribution in spring-summer in the Norwegian and Barents Seas were analysed. Some differences in the phytoplankton vegetation time, the degree of quantitative development and distribution in the eastern and western areas of the Barents Sea were noted. The distribution of deepwater shrimp larvae was investigated, and the habitat of spawning (mature) shrimp populations in the Norwegian and Barents Sea were determined. Daily feeding rations of capelin during intensive fattening were determined. A great amount of material on feeding of haddock yearlings in the Barents Sea in autumn-winter that will permit to discuss their survival in future was analysed.

170 phytoplankton samples, 1360 zooplankton samples, 153 euphausiid samples were taken by the trawl-attached net, 3650 shrimp larvae were identified and measured; quantitative mass analysis of feeding of 400 capelin specimens, 250 blue whiting specimens, 4847 haddock yearlings was carried out.

White Sea

In the White Sea monitoring studies of seasonal and yearly dynamics of plankton was continued on Decade Station DI (Kandalakhsy Bay) and in the Onega Bay. Peculiarities of the biology and life cycle of a number of plankton organisms were studied.

On the basis of mass species studies the ecology of littoral and sublittoral zone was investigated. The distribution of mass species within the complex of the biocenoses from the Kandalakshsky Bay of the White Sea was considered, making it possible to distinguish the group of factors that influenced the space population structure. Plankton and benthos samples collected in cruises in previous years were processed.

In autumn 1981 a cruise of the research vessel "Akademik Petrovsky" aimed at complex investigations of the edge of the Iberis-kyapan was conducted.

Baltic Sea

Zooplankton. Seasonal zooplankton surveys were done in February, May, August and October-November on standard stations (ICES areas 25, 26, 28, 29), in the Gulfs of Finland and Riga - in May, August and October (an extra survey in the Gulf of Riga in July). 650 samples were taken. Samples were taken by Juday net 37/50 with the mesh size of 0.09-0.16 mm in the conical end.

Nekto-benthos. Nekto-benthos surveys were carried out in the eastern and south-eastern Baltic Sea (areas 26 and 28) in April, June, July and September. In the coastal areas of the Gulf of Finland and the north-eastern Gulf of Riga (areas 28 and 32) sampling was done monthly in April - November. Studies were carried out on the total of 117 stations in the Baltic Sea, on 81 stations - in the gulfs. Samples were taken by a 10 feet Isaaks-Kidd trawl using stratified netting (in the sea); a benthopelagic Rass trawl for five-minute trawling in the close to the bottom layer.

Zoobenthos. In the Baltic Sea and the Gulf of Riga zoobenthos samples were collected in April - May and October - November on standard stations in areas 25, 26, 28, 29 and 32. 152 samples were taken by Van-Veen bottom grab with the covering area of 0.01 m^2 .

Feeding of herring. Samples were taken in January, April - May, June - July and September in areas 26 and 28. 1550 fishes were examined.

